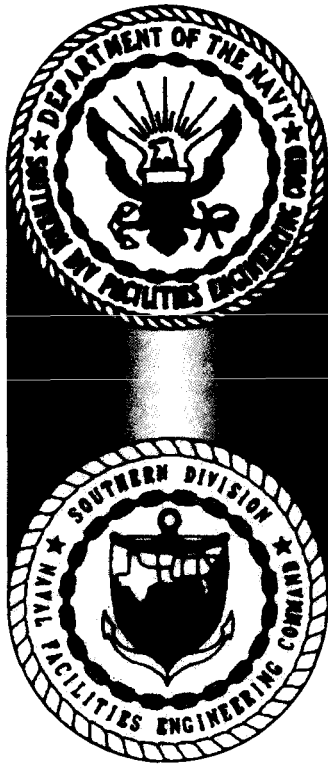


N61165.AR.003341
CNC CHARLESTON
5090.3a

INTERIM MEASURE COMPLETION REPORT IN SITU CHEMICAL OXIDATION OF DDD IN
GROUNDWATER SOLID WASTE MANAGEMENT UNIT 38 (SWMU 38) ZONE A CNC
CHARLESTON SC
9/1/2002
CH2M HILL

INTERIM MEASURE COMPLETION REPORT

In Situ Chemical Oxidation of DDD in Groundwater SWMU 38, Zone A



***Charleston Naval Complex
North Charleston, South Carolina***

SUBMITTED TO
***U.S. Navy Southern Division
Naval Facilities Engineering Command***

CH2M-Jones

September 2002

Contract N62467-99-C-0960



CH2MHILL

CH2M HILL

3011 S.W. Williston Road

Gainesville, FL

32608-3928

Mailing address

P.O. Box 147009

Gainesville, FL

32614-7009

Tel 352.335.7991

Fax 352.335.2959

October 4, 2002

Mr. David Scaturo
South Carolina Department of Health and
Environmental Control
Bureau of Land and Waste Management
2600 Bull Street
Columbia, SC 29201

Re: Corrective Measures Study Report (Revision 0) – SWMU 39, Zone A

Dear Mr. Scaturo:

Enclosed please find four copies of the Corrective Measures Study Report (Revision 0) for SWMU 39 in Zone A of the Charleston Naval Complex (CNC). This report has been prepared pursuant to agreements by the CNC BRAC Cleanup Team for completing the RCRA Corrective Action process.

The principal author of this document is Casey Hudson. Please do not hesitate to contact him at 407/423-0030, extension 251, should you have any questions or comments.

Sincerely,

CH2M HILL

Dean Williamson, P.E.

cc: Rob Harrell/Navy, w/att
Gary Foster/CH2M HILL, w/att

INTERIM MEASURE COMPLETION REPORT

In Situ Chemical Oxidation of DDD in Groundwater SWMU 38, Zone A



***Charleston Naval Complex
North Charleston, South Carolina***

SUBMITTED TO
***U.S. Navy Southern Division
Naval Facilities Engineering Command***

PREPARED BY
CH2M-Jones

September 2002

Revision 0
Contract N62467-99-C-0960
158814.ZA.PR.03


Certification Page for Interim Measure Completion Report (Revision 0) – SWMU 38, Zone A

In Situ Chemical Oxidation of DDD in Groundwater

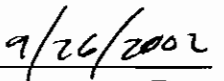
I, Dean Williamson, certify that this report has been prepared under my direct supervision. The data and information are, to the best of my knowledge, accurate and correct, and the report has been prepared in accordance with current standards of practice for engineering.

South Carolina

P.E. No. 21428



Dean Williamson, P.E.



Date

Contents

Section	Page
Acronyms and Abbreviations	vi
1.0 Introduction.....	1-1
1.1 Purpose of the Interim Measure Completion Report	1-1
1.2 Background and Summary of Previous Interim Measures	1-1
1.2.1 Contaminated Soil Interim Measure (Navy/DET)	1-2
1.2.2 Reevaluation of COCs Identified in the <i>Zone A RFI Report, Rev. 0</i>	1-2
1.2.3 Surface Soil Interim Measure (CH2M-Jones).....	1-3
1.2.4 Soil and Groundwater Sampling Prior to Groundwater IM.	1-3
1.3 Report Organization.....	1-4
Figure 1-1 Location of SWMU 38, Zone A	1-5
Figure 1-2 Soil Sample Locations at SWMU 38.....	1-6
2.0 Interim Measure Implementation.....	2-1
2.1 Pre-Interim Measure Activities.....	2-1
2.1.1 Monitoring Well Installation.....	2-1
2.1.2 Baseline Groundwater Sampling.....	2-1
2.1.3 Utility Clearance	2-2
2.2 Interim Measure Execution	2-2
2.3 Post-Interim Measure Performance Sampling	2-2
2.3.1 7-Day Performance Sampling	2-2
2.3.2 30-Day Performance Sampling	2-3
2.3.3 Post-Interim Measure Subsurface Soil Sampling	2-3
2.4 Discussion of Groundwater Interim Measure Outcome.....	2-4
Table 2-1 Compounds Detected in Baseline Groundwater Samples	2-5
Table 2-2 Compounds Detected in 7-Day Performance Samples	2-7
Table 2-3 Compounds Detected in 30-Day Performance Samples	2-9
Table 2-4 Compounds Detected in Post-Interim Measure Subsurface Samples	2-11
Figure 2-1 Monitoring Well Locations	2-12
Figure 2-2 Injection Well Locations	2-13
Figure 2-3 Subsurface Soil Sample Locations.....	2-14
3.0 Previous Soil Interim Measure Summary	3-1
Table 3-1 PCB Concentrations within Exposure Area.....	3-2

Contents, Continued

Table 3-2	Summary of UCL ₉₅ Calculation Result for Aroclor-1254.....	3-5
Table 3-3	Summary of UCL ₉₅ Calculation Results for Aroclor-1260	3-6
Figure 3-1	½-acre Exposure Area	3-7
4.0	Post-Interim Measures Risk Assessment	4-1
4.1	Selection of Residual COCs	4-1
4.1.1	Soil COCs	4-1
4.1.2	Groundwater COCs	4-1
4.2	Toxicity Assessment	4-3
4.3	Exposure Assessment	4-3
4.4	Risk Characterization	4-4
4.4.1	Risks and Hazard Index from SWMU 38-Related Chemicals	4-4
4.4.2	Risks and Hazard Index from all Chemicals in Groundwater in the Vicinity of SWMU 38.....	4-5
4.5	General Considerations	4-5
4.6	Summary and Recommendations	4-5
Table 4-1	Selection of COCs in Soil and Groundwater for Residual Risk Assessment	4-7
Table 4-2	Toxicity Factors Used in Risk Estimations	4-9
Table 4-3	UCL ₉₅ Estimate for COCs Identified in Soil and Groundwater at SWMU 38....	4-11
Table 4-4	Residual Contaminant Risk Summ. for Soil and Groundwater at SWMU 38 ...	4-12
5.0	Recommendations	5-1
6.0	References	6-1

Appendices

A	Responses to SCDHEC Comments on the <i>Interim Measure Work Plan, In Situ Chemical Oxidation of DDD in Groundwater, SWMU 38, Zone A (Revision 0)</i> (CH2M-Jones, 2001b) and the <i>Interim Measure Completion Report, Soil Removal, SWMU 38, Zone A (Revision 0)</i> (CH2M-Jones 2002b)
B	Monitoring Well Installation Logs
C	Risk Calculation Tables

1 Acronyms and Abbreviations

2	AST	Aboveground storage tank
3	CMS WP	Corrective Measures Study Work Plan
4	CNC	Charleston Naval Complex
5	CVOC	Chlorinated volatile organic compound
6	COC	Chemical of concern
7	DET	Environmental Detachment Charleston
8	ELCR	Excess lifetime cancer risk
9	EnSafe	Ensafe Inc.
10	EPA	U.S. Environmental Protection Agency
11	EPC	Exposure point concentration
12	ft bls	Feet below land surface
13	HEAST	Health Effects Assessment Summary Table
14	HHRA	Human Health Risk Assessment
15	HI	Hazard index
16	HI	Hazard quotient
17	IM	Interim Measure
18	IM CR	Interim Measure Completion Report
19	IRIS	Integrated Risk Information System
20	ISCO	In Situ Chemical Oxidation
21	µg/L	Micrograms per liter
22	mg/kg	Milligrams per kilogram
23	MCL	Maximum contaminant level
24	NFA	No further action
25	PCB	Polychlorinated biphenyl
26	RBC	Risk-based concentration
27	SCDHEC	South Carolina Department of Health and Environmental Control
28	SSL	Soil screening level
29	SWMU	Solid waste management unit
30	UCL ₉₅	95-percent Upper Confidence Limit

1 **Acronyms and Abbreviations, Continued**

2	VOC	Volatile organic compound
3	WMI	Waste Management Inc.
4	yd ³	Cubic yards

1.0 Introduction

1.1 Purpose of the Interim Measure Completion Report

This Interim Measure Completion Report (IM CR) presents the results of the recent shallow groundwater IM conducted at Solid Waste Management Unit (SWMU) 38, which used in situ chemical oxidation (ISCO). The results of pre- and post-IM performance monitoring for groundwater and soil are discussed herein.

In addition, responses to South Carolina Department of Health and Environmental Control (SCDHEC)'s comments on the recently submitted IM CR for removal of contaminated surface soil at SWMU 38 are provided in this report. Calculations of 95-percent Upper Confidence Limit (UCL_{95}) values for two polychlorinated biphenyls (PCBs) in surface soil are presented, and these values are compared to the U.S. Environmental Protection Agency (EPA) Region III residential risk-based concentrations (RBCs). A risk assessment for the remaining potential chemicals of concern (COCs) is also presented to evaluate the current site risk and to determine whether additional corrective measures under the RCRA Corrective Action Program are warranted to enable site closeout.

1.2 Background and Summary of Previous Interim Measures

SWMU 38, a Miscellaneous Storage area, is located to the north of Building 1605 along the northern boundary of the Charleston Naval Complex (CNC). Figure 1-1 shows the location of SWMU 38 within Zone A. Figure 1-2 presents the soil sample locations at SWMU 38. Although little historical information is available regarding the site, it has been used as a storage yard, associated with Buildings 1605 and 1604, for approximately 50 years. The site was more recently used for the storage of empty drums.

The *Zone A RFI Report, Revision 0* (EnSafe Inc. [EnSafe], 1998) concluded that the surface soil COCs at SWMU 38 included several metals, a PCB, and pesticides. No COCs were identified for the subsurface soils of SWMU 38 in the RFI report. Groundwater COCs at SWMU 38 were identified as metals and pesticides. Since completion of the RFI, several IMs have been completed at the site, including two that targeted contaminated soil and one that addressed groundwater, as discussed herein. In addition, during the preparation of an IM Work Plan (IM WP) by CH2M-Jones to conduct additional soil and groundwater sampling, the COCs identified in the RFI report were reevaluated using current evaluation criteria. A

brief description of these IMs and the reevaluation of the identified COCs is presented below.

1.2.1 Contaminated Soil Interim Measure (Navy/DET)

An IM (SUPSHIP, 1998) was conducted for the Navy by the Environmental Detachment Charleston (DET) at SWMU 38 to remove pesticide-contaminated soil. The objective for this IM was the removal of soil containing DDT and DDE at concentrations above 6.5 milligrams per kilogram (mg/kg), and DDD concentrations greater than 9.2 mg/kg. Approximately 500 cubic yards (yd³) of surface and subsurface soil were removed during this effort. Subsurface soil was removed to the top of the shallow water table.

Two subsurface soil samples collected during the IM from the bottom of the excavation area reported elevated DDT and DDD concentrations (038S03001: DDD 19.0 mg/kg and DDT 41.6 mg/kg; 038S03101: DDD 123 mg/kg and DDT 388 mg/kg). Resampling of these locations was conducted in 2001 by CH2M-Jones. The resampling results, which did not confirm the presence of pesticides in subsurface soils above COPC screening criteria, were previously discussed in the *Interim Measure Work Plan, In Situ Chemical Oxidation of DDD in Groundwater, SWMU 38, Zone A* (CH2M-Jones, 2001b). Additional post-IM subsurface soil samples from these locations were also collected and analyzed for pesticides as part of the recent groundwater IM. The results of this resampling, presented later in this report, also do not indicate the presence of subsurface soils at levels above COPC screening criteria.

1.2.2 Reevaluation of COCs Identified in the Zone A RFI Report, Revision 0

In preparing the Corrective Measures Study Work Plan (CMS WP) for the initial soil and groundwater resampling effort (CH2M Jones, 2001a), CH2M-Jones evaluated the data collected during the RFI by the Navy/EnSafe team, in addition to data from the IM conducted for the Navy by the DET (1998). This evaluation concluded that the metals that were previously considered to be COCs for surface soil (beryllium, arsenic, and aluminum) were not COCs, and that the PCB Aroclor-1260 did not appear to be a COC for surface soil. The pesticide DDT and its degradation products DDE and DDD were identified as COCs for surface soil under the unrestricted (i.e., residential) land use scenario, in spite of the significant remediation achieved during the DET's IM. For groundwater, DDD and DDT were considered to be COCs, but arsenic and thallium were not considered to be COCs.

Much of the calculated risk for the pesticides in surface soil was related to a single high reported value in one of the DET's confirmation samples. It was concluded that additional soil data would allow a better assessment of the residual surface soil risk after completion of the DET's soil IM. The collection of subsurface soil samples was also recommended to

assess whether leaching of pesticides to groundwater was of concern. Collection of additional surface soil to assess the extent of PCBs was also recommended by SCDHEC, and this additional PCB sampling was completed and formed the basis for a subsequent IM to remove PCB-impacted soil. Collection of additional groundwater samples was also determined to be warranted to assess whether significant pesticide impacts to groundwater had occurred. All of these additional sampling activities have been completed.

1.2.3 Surface Soil Interim Measure (CH2M-Jones)

CH2M-Jones conducted an IM in 2002 to remediate PCB-impacted surface soil at SWMU 38. An IM CR was submitted on June 12, 2002, which summarized the IM and the data collected in support of the IM. SCDHEC issued comments on the IM CR on July 11, 2002. The responses to these comments are provided in Appendix A.

1.2.4 Soil and Groundwater Sampling Prior to Groundwater Interim Measure

Soil sampling proposed in the *Corrective Measures Work Plan, Source Area Delineation, SWMU 38, Zone A* (CH2M Jones, 2001a) was conducted to verify the extent of pesticide-contaminated surface and subsurface soil remaining after the first soil IM by the DET. The results of this sampling were previously reported in the *Interim Measure Work Plan, In Situ Chemical Oxidation of DDD in Groundwater, SWMU 38, Zone A* (CH2M Jones, 2001b).

The results indicated that surface soil concentrations of pesticides were below applicable residential RBCs, and no further remedial efforts for pesticides in surface soil were warranted. The subsurface soil samples collected and analyzed during this effort, which targeted the locations of reported exceedances during the DET's soil IM, did not identify subsurface soils with pesticide concentrations above COPC screening criteria (i.e., soil screening levels [SSLs]).

Pesticides in groundwater above COPC screening criteria were previously detected at SWMU 38 in one well (A038GW001), which is located within the area where the DET conducted the first IM. This well was removed during the IM. In order to determine whether detectable pesticide contamination remained at that location, a replacement well was installed. A groundwater sample was collected from the re-installed well and analyzed for pesticides. The analytical results for DDD (0.97 micrograms per liter [µg/L]) indicated its presence above the RBC (0.28 µg/L). There is no maximum contaminant level (MCL) for DDD.

Because groundwater results for DDD in the replacement well were above screening criteria, CH2M-Jones recommended, and subsequently implemented, an IM using ISCO

(Fenton's reagent). The objective of the IM was to reduce DDD concentrations to below its RBC (i.e., to achieve an approximately 75-percent reduction in concentration). The results of the IM are presented in this IM CR.

1.3 Report Organization

This IM CR consists of the following sections, including this introductory section:

1.0 Introduction — Presents the purpose of the report and background information relating to the IM.

2.0 Interim Measure Implementation — Summarizes the groundwater IM activities at SWMU 38.

3.0 Interim Measure Outcome — Provides a discussion of post-IM activities.

4.0 Recommendations — Provides recommendations for proceeding with site closure.

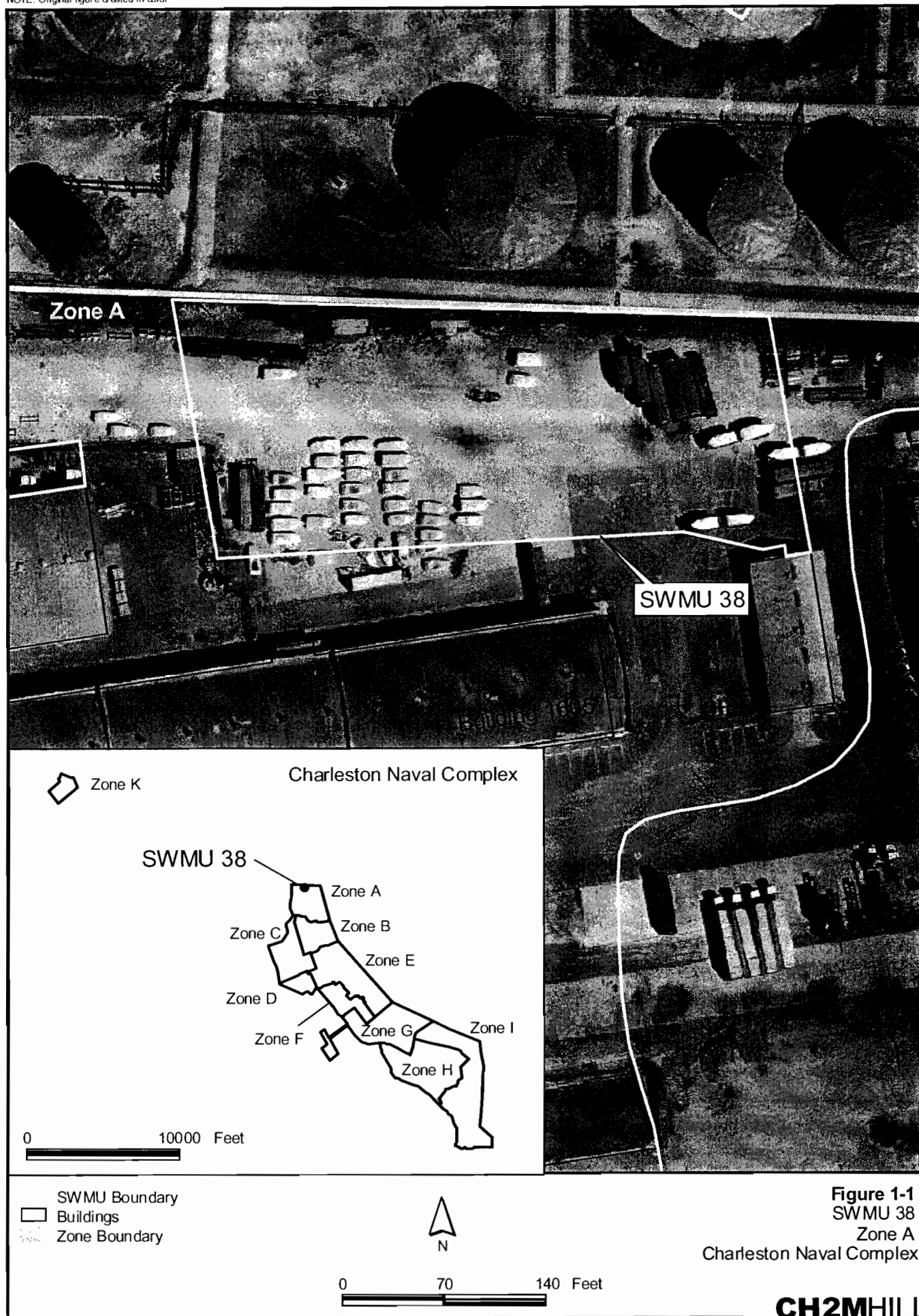
5.0 References — Lists the references used in this document.

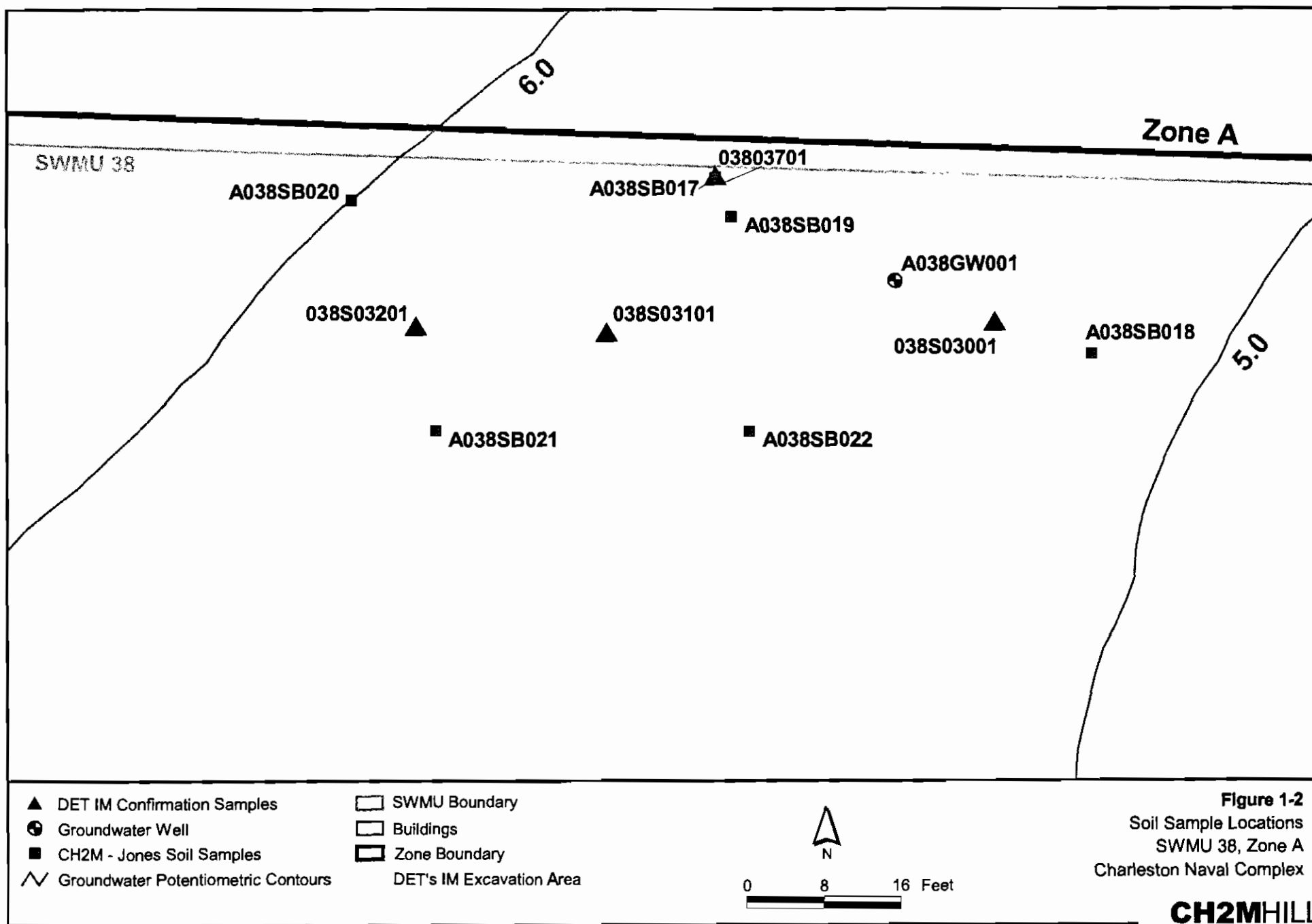
Appendix A contains CH2M-Jones' responses to SCDHEC comments regarding the *Interim Measure Work Plan, In Situ Chemical Oxidation of DDD in Groundwater, SWMU 38, Zone A* (CH2M-Jones, 2001b) and the *Interim Measure Completion Report, Soil Removal, SWMU 38, Zone A, Revision 0* (CH2M-Jones, 2002b).

Appendix B contains the construction logs developed for the monitoring wells installed at SWMU 38.

Appendix C contains the risk calculation data used in developing the risk assessment for soils and groundwater at SWMU 38.

All tables and figures appear at the end of their respective sections.





2.0 Interim Measure Implementation

2.1 Pre-Interim Measure Activities

This section provides a description of the activities conducted prior to the implementation of the groundwater IM at SWMU 38.

2.1.1 Monitoring Well Installation

On February 19, 2002, CH2M-Jones and Columbia Technologies Inc. mobilized to SWMU 38 to install two new groundwater monitoring wells (A038GW004 and A038GW005). These wells were installed to better define the nature and extent of groundwater contamination in the vicinity of monitoring well A038GW001, as requested by SCDHEC and to serve as downgradient monitoring points for the IM. The request for the installation of the monitoring wells was submitted by CH2M-Jones on February 4, 2002, and was subsequently approved by SCDHEC. The construction details for the installation of the monitoring wells are included in Appendix B. The locations of the monitoring wells are presented on Figure 2-1.

On February 27, 2002, CH2M-Jones and Columbia Technologies Inc. mobilized to SWMU 38 to install three injection wells for use in the IM using ISCO. They were installed according to the IM WP (CH2M-Jones, 2001b). The locations of the injection wells are presented on Figure 2-2.

2.1.2 Baseline Groundwater Sampling

In March 2002, groundwater samples were collected from one deep and four shallow wells to provide baseline data for evaluating the effectiveness of the IM. These samples were analyzed for volatile organic compounds (VOCs) and pesticides. A summary of the detected compounds is presented in Table 2-1.

A review of the baseline analytical data shows that DDD was detected in two wells (A038GW001 and A038GW005) at 1.4 and 0.48 $\mu\text{g/L}$, respectively, above its RBC of 0.28 $\mu\text{g/L}$. Vinyl chloride was detected in two wells (A038GW003 and A038GW004) at 25 and 13 $\mu\text{g/L}$, respectively, above its MCL of 2 $\mu\text{g/L}$. Low levels of several other pesticides and VOCs were detected but no other detections exceeded COPC screening criteria. The VOCs are likely from nearby SWMU 39, and not related to SWMU 38. They will be addressed as part of the investigation and subsequent corrective measures at SWMU 39.

The detection of DDD in well A038GW001 was slightly greater than the previous detection of DDD ($0.97 \mu\text{g/L}$) in this well (during the 2001 collection event).

2.1.3 Utility Clearance Related to Hess Oil Utilities

Due to the proximity of SWMU 38 to aboveground storage tanks (ASTs) at the Hess Oil Property and the exothermic nature of the chemical oxidation process, CH2M-Jones contacted Hess Oil (Amerada Hess Corporation) to provide information on subsurface utilities near the site. Additionally, a site visit was made by the CH2M-Jones field team and Mark West of West Enterprises to determine if underground utilities were present near the site boundary. No underground utilities that could pose a problem were identified. However, CH2M-Jones decided not to inject hydrogen peroxide or a catalyst solution into the northernmost injector (injector 2) to provide an additional margin of safety.

2.2 Interim Measure Execution

On June 6, 2002, equipment and personnel were mobilized to SWMU 38 to begin the oxidant injection. The IM was conducted in accordance with the IM WP (CH2M-Jones, 2001b) with the exception that the northern most injector (injector 2) was not used. The proposed volume of hydrogen peroxide was injected into the other two injector wells. The injection process took two days, and a total of 2,968 gallons of catalyst solution and 607.5 gallons of hydrogen peroxide were injected.

2.3 Post-Interim Measure Performance Sampling

2.3.1 7-Day Performance Sampling

On June 14, 2002, groundwater samples were collected from one deep and four shallow monitoring wells. These 7-day performance samples were collected to help evaluate the effectiveness of the IM. The samples were analyzed for VOCs, SVOCs, and pesticides. A summary of the detected compounds is presented in Table 2-2.

A review of the 7-day analytical data shows that DDD concentrations decreased somewhat relative to the pre-injection samples. The DDD concentration in well A038GW001 was reported at $0.86 \mu\text{g/L}$, approximately 40 percent lower than the $1.4 \mu\text{g/L}$ value prior to injection. However, the $0.86 \mu\text{g/L}$ concentration remained above the target RBC value of $0.28 \mu\text{g/L}$. In well A038GW005, the 7-day post-injection value of $0.26 \mu\text{g/L}$ was approximately half that of its pre-injection value ($0.48 \mu\text{g/L}$), and slightly below the target value of $0.28 \mu\text{g/L}$.

Acetone and vinyl chloride were reported at concentrations above their respective screening criteria. Acetone was detected above its RBC (61 µg/L, hazard index [HI]=0.1) in the samples from monitoring wells A038GW001 (580 µg/L) and A038GW005 (1,200 µg/L). The reported presence of acetone may be due to its presence in isopropanol, which is used for field equipment decontamination, or due to laboratory contamination. However, it may also be a byproduct of the reaction of Fenton's reagent oxidants with natural organic material. Vinyl chloride was detected at a concentration above its MCL (2 µg/L) in the sample from monitoring well A038GW003 (17 µg/L). As previously indicated, vinyl chloride is not believed to be related to SWMU 38 operations.

2.3.2 30-Day Performance Sampling

On July 17, 2002, groundwater samples were collected from four shallow and one deep monitoring wells. The 30-day performance samples were collected to help evaluate the effectiveness of the IM. The samples were analyzed for VOCs, SVOCs, and pesticides. A summary of the detected compounds is presented in Table 2-3.

A review of the 30-day performance sample analytical data shows that DDD in well A38GW001 appeared to rebound to its pre-injection concentration (1.4 µg/L). The reason for this rebound is not clear. The DDD concentration detected in well A38GW005 (0.24 J µg/L), however, remained below its pre-injection concentration and below the RBC of 0.28 µg/L.

Vinyl chloride was detected at a concentration above its MCL (2 µg/L) in the samples from monitoring wells A038GW001 (3.1 J µg/L), A038GW003 (19 µg/L), and A038GW004 (3.9 J µg/L). As previously discussed, the presence of the chlorinated solvents and their breakdown products are likely from nearby SWMU 39 and will be addressed as part of the remedial efforts at SWMU 39. Acetone and methyl ethyl ketone were not detected in the 30-day performance samples.

2.3.3 Post-Interim Measure Subsurface Soil Sampling

Subsurface soil samples were also collected after the IM at the locations of 038S03001 and 03803101, where the DET's IM data had reported elevated pesticides, but which resampling by CH2M-Jones did not previously confirm. Samples were collected at the original target depth (approximate top of water table) and approximately 1 ft below this elevation in the saturated zone. Table 2-4 presents a summary of the detected compounds in these samples.

Five pesticides (endrin ketone, gamma-chlordane, DDD, DDE, and DDT) and two VOCs (acetone and 2-butanone) were detected. None of the detected chemicals exceeded their respective SSLs.

2.4 Discussion of Groundwater Interim Measure Outcome

The outcome of the groundwater IM can be described as partially successful. The DDD concentration in well A38GW005, which exceeded the RBC prior to the IM, did not exceed the RBC in either the 7- or 30-day post-IM monitoring. Thus, this area appears to have been successfully treated. However, the DDD concentration in well A39GW001, although originally reduced, remained above the RBC at the 7-day post-IM sampling and rebounded in the 30 day post-IM monitoring to its value immediately prior to the IM.

There are several potential reasons as to why the IM was not completely successful. First, because the concentrations of the target compound DDD are relatively low (around 1 $\mu\text{g/L}$), the reaction kinetics may not have been favorable for DDD oxidation relative to other organic chemicals present, including naturally occurring organics. Other organic compounds, such as natural organic matter, that are present in the soil at much greater concentrations than the DDD may have reacted preferentially with the oxidant, thereby reducing the amount of DDD treated. Reactions of Fenton's reagent with naturally occurring organic chemicals occur during all ISCO projects, however, because the target chemicals are typically also present at much higher concentrations, they are more competitive for oxidation reactions with the relatively short-lived hydroxyl radicals created by the Fenton's reagent.

DDD is highly hydrophobic and binds strongly to soil particles. DDD bound to soil particles may have partially been shielded by the soil particles from the oxidant. In addition, the detected levels of DDD reported in these wells may have been impacted by turbidity, with minor amounts of DDD bound to particulates impacting the reported values. The collection of filtered versus unfiltered samples may clarify this issue.

Finally, the results of the soil confirmation sampling indicate that no subsurface soil was identified at concentrations above the COPC screening criteria. The greatest concentrations of DDD were detected at the elevation nearest to the top of the water table (approximately 6 to 7 feet below land surface [ft bls]). Concentrations of DDD and other pesticides in samples collected beneath this elevation had lower concentrations, indicating that the depth of pesticide contamination is limited. Given that the pesticide concentrations do not extend significantly beneath the top of the water table and that the DET excavated the pesticide contaminated soil down to the top of the water table, there appear to be only very minor amounts of pesticides remaining in the soil and their concentrations are below the COPC screening criteria.

TABLE 2-1

Compounds Detected in Baseline Groundwater Samples

Interim Measure Completion Report, SWMU 38, Zone A, Charleston Naval Complex

Chemical	Station ID	Sample ID	Date Collected	Concentration (µg/L)	Qualifier	MCL	EPA Region III RBC (HI=0.1)
Pesticides							
Alpha-Chlordane	A038GW004	038GW004M3	14-Mar-02	0.019	J	2	NA
Endosulfan Sulfate	A038GW004	038GW004M3	14-Mar-02	0.022	J	NA	22 _{endosulfan}
Endrin	A038GW004	038GW004M3	14-Mar-02	0.021	J	2	NA
Endrin Ketone	A038GW004	038GW004M3	14-Mar-02	0.02	J	2 _{endrn}	NA
Heptachlor	A038GW004	038GW004M3	14-Mar-02	0.0094	J	0.4	NA
p,p'-DDD	A038GW001	038GW001M4	02-Apr-02	1.4	J	NA	0.28
	A038GW004	038GW004M3	14-Mar-02	0.074	J		
	A038GW005	038GW005M3	14-Mar-02	0.48	J		
p,p'-DDE	A038GW004	038GW004M3	14-Mar-02	0.024	J	NA	0.20
p,p'-DDT	A038GW004	038GW004M3	14-Mar-02	0.022	J	NA	0.20
VOCs							
1,2-Dichlorobenzene	A038GW004	038GW004M2	04-Mar-02	0.59	J	600	NA
1,2-DCE (total)	A038GW001	038GW001M2	04-Mar-02	1.4	J	70 _{cis-} 1,2dichloro ethene	NA
	A038GW003	038GW003M2		7.1	=		
1,2-DCE (total)	A038GW004	038GW004M2	04-Mar-02	6.6	=	70 _{cis-} 1,2dichloro ethene	NA
	A038GW005	038GW005M2	04-Mar-02	2.3	J		
cis-1,2-DCE	A038GW001	038GW001M2	04-Mar-02	1.4	J	70	NA
	A038GW003	038GW003M2	04-Mar-02	5.1	=		
	A038GW004	038GW004M2	04-Mar-02	4.3	J		
	A038GW005	038GW005M2	04-Mar-02	1.7	J		
trans-1,2-DCE	A038GW003	038GW003M2	04-Mar-02	2.1	J	100	NA
	A038GW004	038GW004M2	04-Mar-02	2.3	J		
	A038GW005	038GW005M2	04-Mar-02	0.62	J		

TABLE 2-1
 Compounds Detected in Baseline Groundwater Samples
Interim Measure Completion Report, SWMU 38, Zone A, Charleston Naval Complex

Chemical	Station ID	Sample ID	Date Collected	Concentration (µg/L)	Qualifier	MCL	EPA Region III RBC (HI=0.1)
Vinyl chloride	A038GW001	038GW001M2	04-Mar-02	1.9	J	2	NA
	A038GW003	038GW003M2	04-Mar-02	25	=		
	A038GW004	038GW004M2	04-Mar-02	13	=		
	A038GW005	038GW005M2	04-Mar-02	1.5	J		

Concentrations that are in bold text and outlined within the table represent exceedances of the screening criterion(a).

J indicates that the compound was detected. The reported value is the estimated detection limit.

= indicates that the compound was detected. The reported value is the measured concentration.

The maximum contaminant levels (MCLs) are from the *National Primary Drinking Water Standards* (EPA, 3/2001).

Risk-based concentrations (RBCs) are used in the absence of an applicable MCL.

RBCs are based on a hazard index (HI) of 0.1 for non-carcinogenic compounds.

Compounds listed in subscript next to the MCLs and RBCs are the surrogate compound used for comparison.

NA indicates that the information is not available or not applicable.

p,p'-DDD dichlorodiphenyldichloroethane

p,p'-DDE dichlorodiphenyldichloroethene

p,p'-DDT dichlorodiphenyltrichloroethane

TABLE 2-2

Compounds Detected in 7-day Performance Samples

Interim Measure Completion Report, SWMU 38, Zone A, Charleston Naval Complex

Chemical	Station ID	Sample ID	Date Collected	Concentration (µg/L)	Qualifier	MCL	EPA Region III RBC (HI=0.1)
Pesticides							
Beta-BHC	A038GW005	038GW005M7	14-Jun-02	0.027	J	NA	0.037
Gamma-Chlordane	A038GW001	038GW001M7	14-Jun-02	0.019	J	2	NA
	A038GW005	038GW005M7	14-Jun-02	0.0078	J		
p,p'-DDD	A038GW001	038GW001M7	14-Jun-02	0.86	=	NA	0.28
	A038GW004	038GW004M7RE	14-Jun-02	0.046	J		
	A038GW005	038GW005M7	14-Jun-02	0.26	J		
SVOC							
Phenol	A038GW001	038GW001M7	14-Jun-02	7.6	J	NA	2,190
VOCs							
1,2-DCE (total)	A038GW003	038GW003M7	14-Jun-02	8.3	=	70 _{cis-1,2dichloroethene}	NA
Acetone	A038GW001	038GW001M7DL	14-Jun-02	580	=	NA	61
	A038GW004	038GW004M7	14-Jun-02	10	=		
	A038GW005	038GW005M7DL	14-Jun-02	1,200	=		
cis-1,2-DCE	A038GW003	038GW003M7	14-Jun-02	6.4	=	70	NA
Methyl ethyl ketone (2-Butanone)	A038GW005	038GW005M7	14-Jun-02	94	=	NA	191
trans-1,2-DCE	A038GW003	038GW003M7	14-Jun-02	1.9	J	100	NA
Vinyl chloride	A038GW001	038GW001M7	14-Jun-02	0.51	J	2	NA
	A038GW003	038GW003M7	14-Jun-02	17	=		

Concentrations that are in bold and outlined within the table indicate exceedances of the screening criterion(a).

J indicates that the compound was detected. The reported value is the estimated detection limit.

= indicates that the compound was detected. The reported value is the measured concentration.

The maximum contaminant levels (MCLs) are from the *National Primary Drinking Water Standards* (EPA, 3/2001).

Risk based concentrations (RBCs) are used in the absence of an applicable MCL.

RBCs are based on a hazard index (HI) of 0.1 for non-carcinogenic compounds.

Compounds listed in subscript next to the MCLs and RBCs are the surrogate compound used for comparison.

NA indicates that the information is not available or not applicable.

TABLE 2-2

Compounds Detected in 7-day Performance Samples

Interim Measure Completion Report, SWMU 38, Zone A, Charleston Naval Complex

Chemical	Station ID	Sample ID	Date Collected	Concentration ($\mu\text{g/L}$)	Qualifier	MCL	EPA Region III RBC (HI=0.1)
p,p'-DDD dichlorodiphenyldicloroethane							
p,p'-DDE dichlorodiphenyldicloroethene							
p,p'-DDT dichlorodiphenyltrichloroethane							

TABLE 2-3
 Compounds Detected in 30-day Performance Samples
Interim Measure Completion Report, SWMU 38, Zone A, Charleston Naval Complex

Chemical	Station ID	Sample ID	Date Collected	Concentration (µg/L)	Qualifier	MCL	EPA Region III RBC (HI=0.1)
Pesticides							
Heptachlor	A038GW001	038GW001M8	17-Jul-02	0.03	J	0.4	NA
p,p'-DDD	A038GW001	038GW001M8	17-Jul-02	1.4	=	NA	0.28
	A038GW004	038GW004M8	17-Jul-02	0.05	J		
	A038GW005	038GW005M8	17-Jul-02	0.24	J		
p,p'-DDE	A038GW001	038GW001M8	17-Jul-02	0.017	J	NA	0.20
	A038GW004	038GW004M8	17-Jul-02	0.034	J		
VOCs							
1,2-DCE (total)	A038GW001	038GW001M8	17-Jul-02	4.4	J	70 _{CIS-} 1,2dichloroethene	NA
	A038GW003	038GW003M8	17-Jul-02	7.2	=		
	A038GW004	038GW004M8	17-Jul-02	2.4	J		
	A038GW005	038GW005M8	17-Jul-02	0.66	J		
cis-1,2-DCE	A038GW001	038GW001M8	17-Jul-02	3.8	J	70	NA
	A038GW003	038GW003M8	17-Jul-02	5.7	=		
	A038GW004	038GW004M8	17-Jul-02	1.6	J		
	A038GW005	038GW005M8	17-Jul-02	0.66	J		
trans-1,2-DCE	A038GW001	038GW001M8	17-Jul-02	0.63	J	100	NA
	A038GW003	038GW003M8	17-Jul-02	1.5	J		
	A038GW004	038GW004M8	17-Jul-02	0.73	J		
TCE	A038GW001	038GW001M8	17-Jul-02	0.97	J	5	NA
Vinyl chloride	A038GW001	038GW001M8	17-Jul-02	3.1	J	2	NA
	A038GW003	038GW003M8	17-Jul-02	19	=		
	A038GW004	038GW004M8	17-Jul-02	3.9	J		

Concentrations that are in bold and outlined within the table indicate exceedances of the criterion(a).

J indicates that the compound was detected. The reported value is the estimated detection limit.

= indicates that the compound was detected. The reported value is the measured concentration.

The maximum contaminant levels (MCLs) are from the *National Primary Drinking Water Standards* (EPA, 3/2001).

Risk-based concentrations (RBCs) are used in the absence of an applicable MCL.

RBCs are based on a hazard index (HI) of 0.1 for non-carcinogenic compounds.

TABLE 2-3

Compounds Detected in 30-day Performance Samples

Interim Measure Completion Report, SWMU 38, Zone A, Charleston Naval Complex

Chemical	Station ID	Sample ID	Date Collected	Concentration (µg/L)	Qualifier	MCL	EPA Region III RBC (HI=0.1)
Compounds listed in subscript next to the MCLs and RBCs are the surrogate compound used for comparison.							
NA indicates that the information is not available or not applicable.							
p,p'-DDD							dichlorodiphenyldichloroethane
p,p'-DDE							dichlorodiphenyldichloroethene
p,p'-DDT							dichlorodiphenyltrichloroethane

TABLE 2-4

Compounds Detected in Post-IM Subsurface Soil Samples
Interim Measure Completion Report, SWMU 38, Zone A, Charleston Naval Complex

Chemical	Station ID	Sample ID	Date Collected	Concentration (µg/kg)	Qualifier	SSL (DAF=10)
Pesticides						
Endrin Ketone	A038SB034	038SB03404	21-Jun-02	0.0012	J	0.5 ^{endrin}
	A038SB035	038SB03503	21-Jun-02	0.0017	J	
Gamma-chlordane	A038SB034	038SB03403	21-Jun-02	0.015	J	5 ^{chlordane}
p,p'-DDD	A038SB034	038SB03403	21-Jun-02	1.1	=	8
	A038SB035	038SB03504RE	21-Jun-02	0.00057	J	
	A038SB035	038SB03503DL	21-Jun-02	3.8	=	
p,p'-DDE	A038SB034	038SB03403	21-Jun-02	0.039	J	27
	A038SB035	038SB03503DL	21-Jun-02	0.11	J	
p,p'-DDT	A038SB034	038SB03403	21-Jun-02	0.85	=	16
	A038SB035	038SB03503DL	21-Jun-02	0.77	=	
VOCs						
Acetone	A038SB034	038SB03404	21-Jun-02	0.074	J	0.8
Methyl ethyl ketone (2-Butanone)	A038SB034	038SB03403	21-Jun-02	0.0047	J	0.4 ^{Reg III RBC Table}
	A038SB034	038SB03404	21-Jun-02	0.0056	J	
	A038SB035	038SB03503	21-Jun-02	0.005	J	
	A038SB035	038SB03504	21-Jun-02	0.004	J	

Sample 038SB03403 was collected at 6.2 to 7.0 ft below land surface (bls).

Sample 038SB03404 was collected at 8.0 to 8.2 ft bls.

Sample 038SB03503 was collected at 6.2 to 6.5 ft bls.

Sample 038SB03504 was collected at 8.0 to 8.5 ft bls.

J indicates that the compound was detected. The reported value is the estimated detection limit.

= indicates that the compound was detected. The reported value is the measured concentration.

SSLs are from the *Soil Screening Guidance: Technical Background Document* (EPA,1996) unless otherwise indicated.

Generic SSLs are based on a dilution-attenuation factor (DAF) of 1 for VOCs and 10 for all other compounds.

The source for SSLs other than from the Soil Screening Guidance are indicated in superscript next to the value.

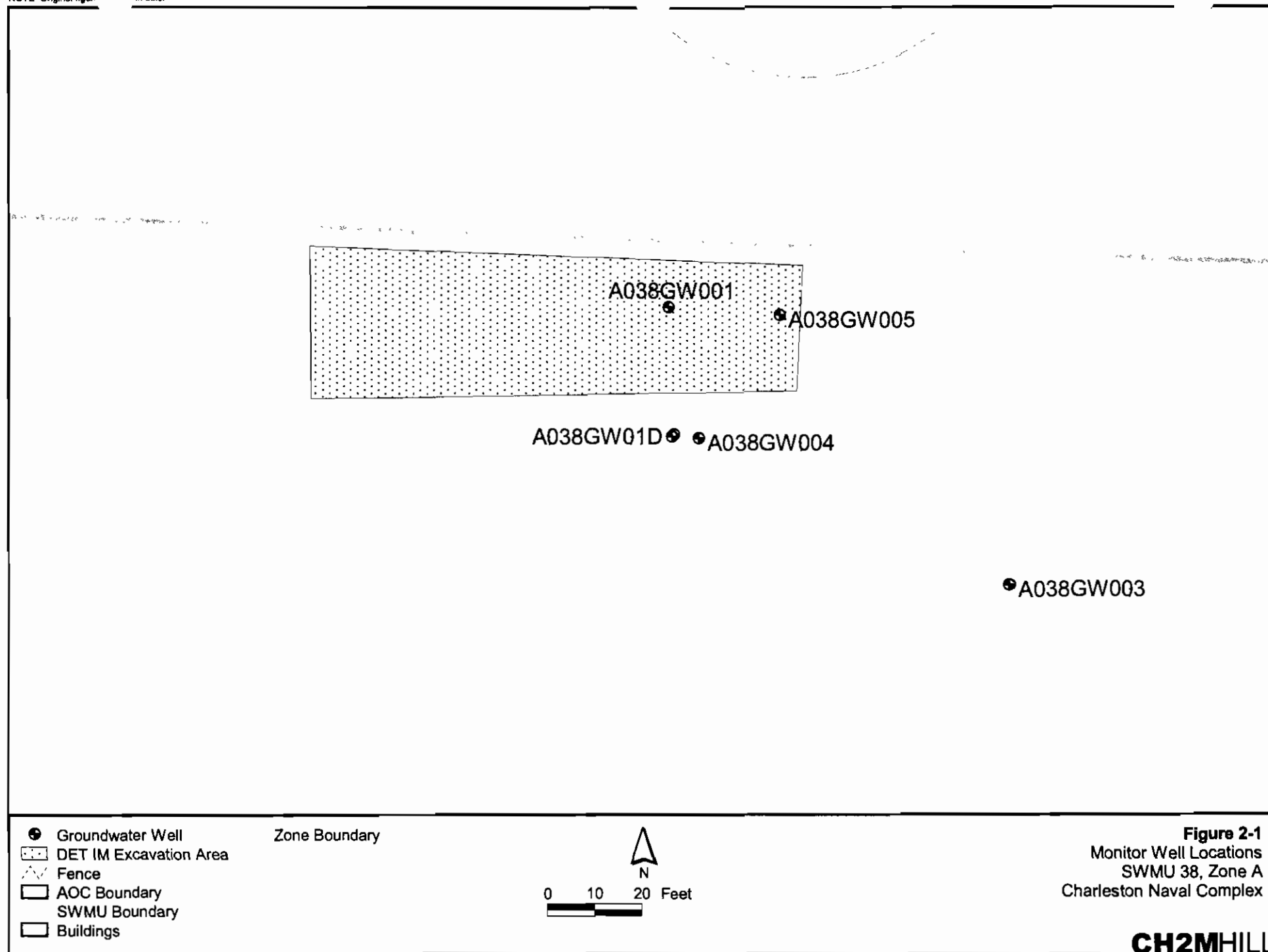
Surrogate compounds for SSLs are indicated in subscript next to the value.

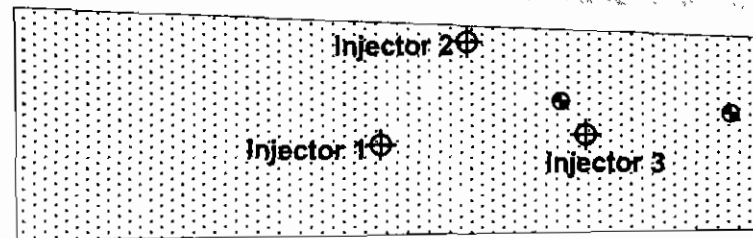
NA indicates that the information is not available or not applicable.

p,p'-DDD dichlorodiphenyldichloroethane

p,p'-DDE dichlorodiphenyldichloroethene

p,p'-DDT dichlorodiphenyltrichloroethane



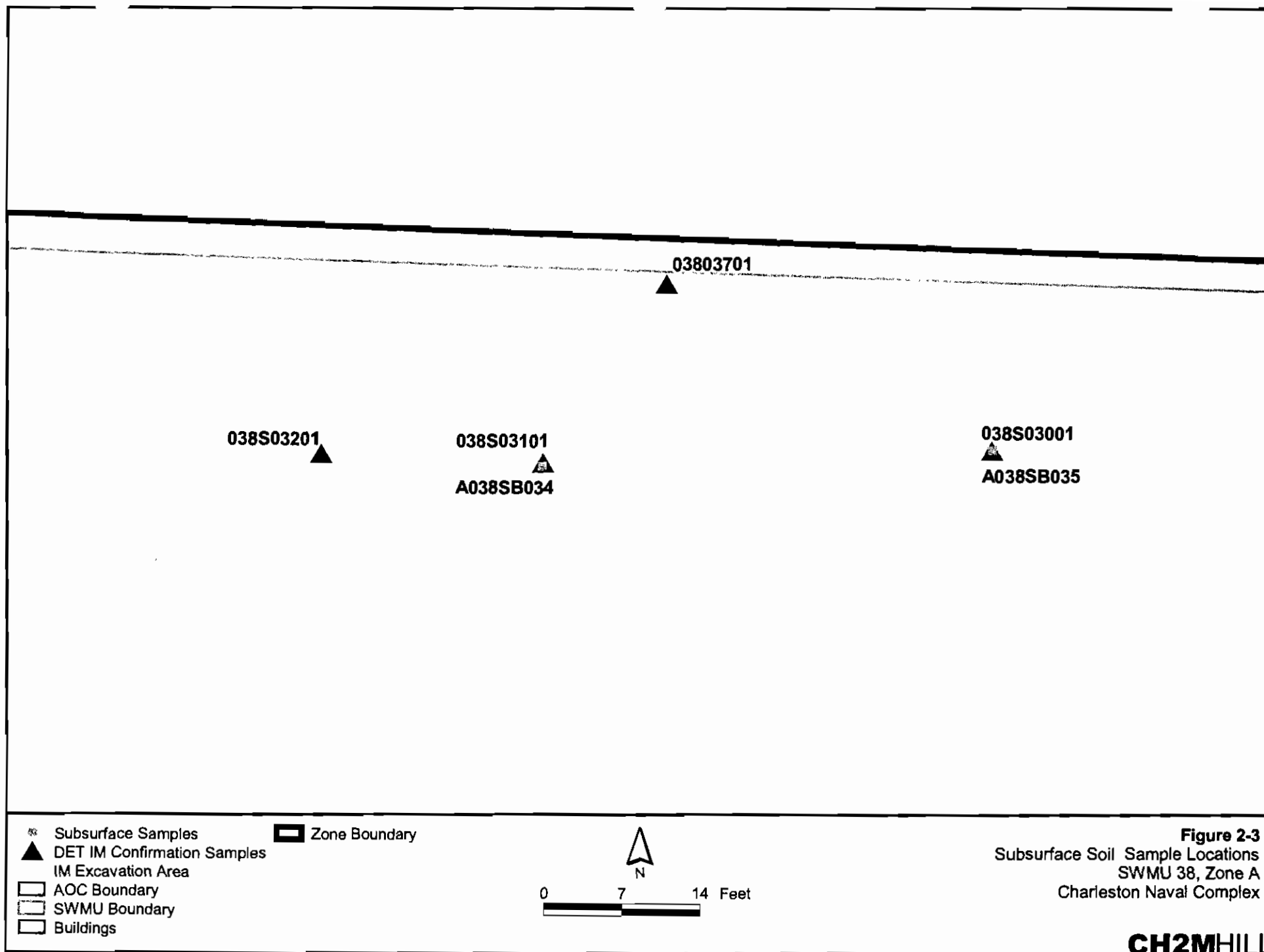


- Injection Wells
- Groundwater Well
- DET IM Excavation Area
- Fence
- AOC Boundary
- SWMU Boundary
- Buildings
- Zone Boundary



Figure 2-2
Injection Well Locations
SWMU 38, Zone A
Charleston Naval Complex

CH2MHILL



3.0 Previous Soil Interim Measure Summary

As previously discussed in the *Interim Measure Completion Report, Soil Removal, SWMU 38, Zone A* (CH2M Jones, 2002b), CH2M-Jones determined that the removal of PCB-impacted soil was appropriate at SWMU 38 to enable closure of the site. An IM WP was developed (CH2M-Jones, 2002a) and subsequently approved by SCDHEC. The IM was implemented in May 2002, and the IM CR (CH2M-Jones, 2002b) was submitted to SCDHEC in June 2002, summarizing the IM and the data collected to support it. SCDHEC issued comments on the soil removal IM CR on July 11, 2002. Among the comments was a recommendation to evaluate the residual risk associated with the remaining PCB concentrations in soil.

SCDHEC recommended calculating an exposure concentration (UCL_{95}) for the detected PCBs (Aroclor-1254 and Aroclor-1260) and comparing the exposure concentration (UCL_{95}) to the RBCs. CH2M-Jones calculated the UCL_{95} for the two detected PCBs at SWMU 38, with a $\frac{1}{2}$ -acre exposure area assumed. The exposure area is shown in Figure 3-1, with the 11 sample locations within the exposure area that were previously analyzed for PCBs.

The calculation used the reported concentration for samples within the exposure area where the PCB was detected, and half the reporting limit value for samples where PCBs were not detected. For excavated soils, previous sample concentrations were replaced with the fill material analytical results, which were all non-detects with a detection limit value of 0.016 mg/kg. The sample results used in the UCL_{95} calculation are provided in Table 3-1. A summary of the UCL_{95} calculation is presented in Tables 3-2 and 3-3 for Aroclor-1254 and Aroclor-1260, respectively.

As presented in these tables, the UCL_{95} values for Aroclor-1254 and Aroclor-1260 are 0.029 mg/kg and 0.24 mg/kg, respectively, using the Bootstrap method. These values are below the EPA Region III residential RBC of 0.32 mg/kg for both Aroclor-1254 and Aroclor-1260. The UCL_{95} values were included in a risk assessment to assess the cumulative risks to a future residential receptor at the site under the post-IM conditions, as described in Section 4.0.

Table 3-1 also includes previous site data for the DDD, DDE, and DDT-impacted soil that was addressed as part of the DET's IM. Soil at sample locations with station IDs A038SB01, A038SB03, A038SB012, and A038SB023 in Table 3-1 were removed as part of the DET's IM and/or as part of the PCB-impacted soil IM. The clean fill brought to the site was analyzed, and did not have detectable concentrations of pesticides. Therefore, these values are replaced with detection limits, as listed in Table 3-1. The residual concentrations for DDD, DDE, and DDT were used to assess current potential site risks, as presented in Section 4.0.

TABLE 3-1
 PCB Concentrations within Exposure Area
 Interim Measure Completion Report, SWMU 38, Zone A, Charleston Naval Complex

Chemical	Station ID	Sample ID	Date Collected	Concentration (mg/Kg)	Qualifier	Adjusted Concentration ^a	Qualifier
Aroclor-1254	A038SB005	038SB00501	10/03/1995	0.0160	U	0.0160	U
	A038SB006	038SB00601	10/03/1995	0.0160	U	0.0160	U
	A038SB011	038SB01101	06/18/1996	0.0140	U	0.0140	U
	A038SB012 _R	038SB01201	06/18/1996	0.0150	U	0.0160	U
	A038SB013	038SB01301	06/18/1996	0.0170	U	0.0170	U
	A038SB015 _R	038SB01501	09/27/2001	2.40	J	0.0160	U
	A038SB016	038SB01601	09/27/2001	0.0810	U	0.0810	U
	A038SB023 _R	038SB02301	11/30/2001	6.80	=	0.0160	U
	A038SB024 _R	038SB02401	01/15/2002	1.41	J	0.0160	U
	A038SB025	038SB02501	01/15/2002	0.0492	J	0.0492	J
	A038SB026	038SB02601	01/15/2002	0.0642	J	0.0642	J
Aroclor-1260	A038SB005	038SB00501	10/03/1995	0.0160	U	0.0160	U
	A038SB006	038SB00601	10/03/1995	0.500	=	0.500	=
	A038SB011	038SB01101	06/18/1996	0.720	=	0.720	=
	A038SB012 _R	038SB01201	06/18/1996	1.30	=	0.0160	U
	A038SB013	038SB01301	06/18/1996	0.0180	=	0.0180	=
	A038SB015 _R	038SB01501	09/27/2001	0.840	J	0.0160	U
	A038SB016	038SB01601	09/27/2001	0.0810	U	0.0810	U
	A038SB023 _R	038SB02301	11/30/2001	0.750	U	0.0160	U
	A038SB024 _R	038SB02401	01/15/2002	0.840	J	0.0160	U
	A038SB025	038SB02501	01/15/2002	0.0310	J	0.0310	J
	A038SB026	038SB02601	01/15/2002	0.0537	J	0.0537	J
p,p'-DDD	A038SB001 _R	038SB00101	10/03/1995	450	J	0.0026	U
	A038SB002	038SB00201	10/03/1995	0.0016	J	0.0016	J
	A038SB003 _R	038SB00301	10/03/1995	3.30	=	0.0026	U
	A038SB004	038SB00401	10/03/1995	0.0053	U	0.0053	U
	A038SB005	038SB00501	10/03/1995	0.0040	U	0.0040	U
	A038SB006	038SB00601	10/03/1995	0.059	=	0.059	=
	A038SB007	038SB00701	03/26/1996	0.050	J	0.050	J

TABLE 3-1
 PCB Concentrations within Exposure Area
Interim Measure Completion Report, SWMU 38, Zone A, Charleston Naval Complex

Chemical	Station ID	Sample ID	Date Collected	Concentration (mg/Kg)	Qualifier	Adjusted Concentration ^a	Qualifier
p,p'-DDD	A038SB008	038SB00801	03/26/1996	0.0027	U	0.0027	U
	A038SB009	038SB00901	03/26/1996	0.0034	U	0.0034	U
	A038SB010	038SB01001	03/26/1996	0.044	J	0.044	J
	A038SB011	038SB01101	06/18/1996	0.21	=	0.21	=
	A038SB012 _R	038SB01201	06/18/1996	0.19	J	0.0026	U
	A038SB013	038SB01301	06/18/1996	0.0042	U	0.0042	U
	A038SB014	038SB01401	06/18/1996	0.29	=	0.29	=
	A038SB017	038SB01701	09/27/2001	0.12	=	0.12	=
	A038SB023 _R	038SB02301	11/30/2001	0.028	U	0.0026	U
p,p'-DDE	A038SB001 _R	038SB00101	10/03/1995	37.0	J	0.0026	U
	A038SB002	038SB00201	10/03/1995	0.0082	=	0.0082	=
	A038SB003 _R	038SB00301	10/03/1995	0.45	=	0.0026	U
	A038SB004	038SB00401	10/03/1995	0.0053	U	0.0053	U
	A038SB005	038SB00501	10/03/1995	0.0040	U	0.0040	U
	A038SB006	038SB00601	10/03/1995	0.17	=	0.17	=
	A038SB007	038SB00701	03/26/1996	0.17	J	0.17	J
	A038SB008	038SB00801	03/26/1996	0.0068	J	0.0068	J
	A038SB009	038SB00901	03/26/1996	0.0034	U	0.0034	U
	A038SB010	038SB01001	03/26/1996	0.057	J	0.057	J
	A038SB011	038SB01101	06/18/1996	0.53	=	0.53	=
	A038SB012 _R	038SB01201	06/18/1996	0.17	=	0.0026	U
	A038SB013	038SB01301	06/18/1996	0.012	=	0.012	=
	A038SB014	038SB01401	06/18/1996	0.58	=	0.58	=
	A038SB017	038SB01701	09/27/2001	0.11	=	0.11	=
	A038SB023 _R	038SB02301	11/30/2001	0.13	J	0.0026	U
p,p'-DDT	A038SB001 _R	038SB00101	10/03/1995	1000	J	0.0026	U
	A038SB002	038SB00201	10/03/1995	0.030	U	0.030	U
	A038SB003 _R	038SB00301	10/03/1995	7.80	J	0.0026	U
	A038SB004	038SB00401	10/03/1995	0.020	U	0.020	U
	A038SB005	038SB00501	10/03/1995	0.0040	U	0.0040	U

TABLE 3-1
 PCB Concentrations within Exposure Area
Interim Measure Completion Report, SWMU 38, Zone A, Charleston Naval Complex

Chemical	Station ID	Sample ID	Date Collected	Concentration (mg/Kg)	Qualifier	Adjusted Concentration ^a	Qualifier
p,p'-DDT	A038SB006	038SB00601	10/03/1995	0.37	J	0.37	J
	A038SB007	038SB00701	03/26/1996	0.077	J	0.077	J
	A038SB008	038SB00801	03/26/1996	0.021	J	0.021	J
	A038SB009	038SB00901	03/26/1996	0.0034	U	0.0034	U
	A038SB010	038SB01001	03/26/1996	0.46	J	0.46	J
	A038SB011	038SB01101	06/18/1996	1.40	=	1.40	=
	A038SB012 _R	038SB01201	06/18/1996	0.80	=	0.0026	U
	A038SB013	038SB01301	06/18/1996	0.054	=	0.054	=
	A038SB014	038SB01401	06/18/1996	1.70	=	1.70	=
	A038SB017	038SB01701	09/27/2001	0.64	=	0.64	=
	A038SB023 _R	038SB02301	11/30/2001	0.50	J	0.0026	U

^a Analytical results for removed samples was replaced with the results from the fill material. Other results are unaffected.

_R indicates that the sample location was removed during the IM

U indicates that the compound was not detected. The reported value is the detection limit.

J indicates that the compound was detected. The reported value is an estimated detection limit.

= indicates that the compound was detected. The reported value is the measured concentration.

TABLE 3-2

Summary of UCL₉₅ Calculation Result for Aroclor-1254
Interim Measure Completion Report, SWMU 38, Zone A, Charleston Naval Complex

STATISTICS	
N	11
Detects	2
FOD	18%
Mean of Detect	0.057
Min of Detect	0.0492
Max of Detect	0.06
Best Estimate of Mean (arithmetic)	0.029
Best Estimate of Mean (geometric)	0.013
Nondetects at 1/2 DL	YES
95% UPPER CONFIDENCE LIMITS FOR MEAN	
UCL95 Normal	0.03
<i>t</i> -statistic	1.81
UCL95 Lognormal	0.0
<i>H</i> -statistic	2.64
UCL95 Nonparametric	0.008
UCL95 Bootstrap	0.029

DISTRIBUTION TESTING

Population is best described as:	NONPARAMETRIC
Wnormal	0.642
Wlog	0.648
Wa = 0.05	0.850

Notes:

1. If population does not fit normal or lognormal distribution, check Q-Q plots and W-test values. The population may be close enough to one of those distributions to subjectively select a normal or lognormal distribution.
2. For site data, if the selected UCL₉₅ exceeds the Max Detect, the Max Detect should be chosen as the EPC.
3. Lognormal UCL or UTL values calculated for less than 30 samples may be widely inflated.
4. If there is >90% nondetection, it is generally impossible to calculate a UTL or UCL with any level of confidence.

TABLE 3-3
 Summary of UCL₉₅ Calculation Result for Aroclor-1260
Interim Measure Completion Report, SWMU 38, Zone A, Charleston Naval Complex

STATISTICS		
N	11	
Detects	5	
FOD	45%	
Mean of Detect	0.265	
Min of Detect	0.0180	
Max of Detect	0.72	
Best Estimate of Mean (arithmetic)	0.2	
Best Estimate of Mean (geometric)	0.03	
Nondetects at 1/2 DL	YES	
95% UPPER CONFIDENCE LIMITS FOR MEAN		
UCL95 Normal	0.26	
<i>t</i> -statistic	1.81	
UCL95 Lognormal	1.0	Exceeds Max Detect
<i>H</i> -statistic	4.05	
UCL95 Nonparametric	0.008	
UCL95 Bootstrap	0.238	
DISTRIBUTION TESTING		
Population is best described as:	NONPARAMETRIC	
Wnormal	0.562	
Wlog	0.787	
Wa = 0.05	0.850	

Notes:

1. If population does not fit normal or lognormal distribution, check Q-Q plots and W-test values. The population may be close enough to one of those distributions to subjectively select a normal or lognormal distribution.
2. For site data, if the selected UCL95 exceeds the Max Detect, the Max Detect should be chosen as the EPC.
3. Lognormal UCL or UTL values calculated for less than 30 samples may be widely inflated.
4. If there is >90% nondetection, it is generally impossible to calculate a UTL or UCL with any level of confidence.

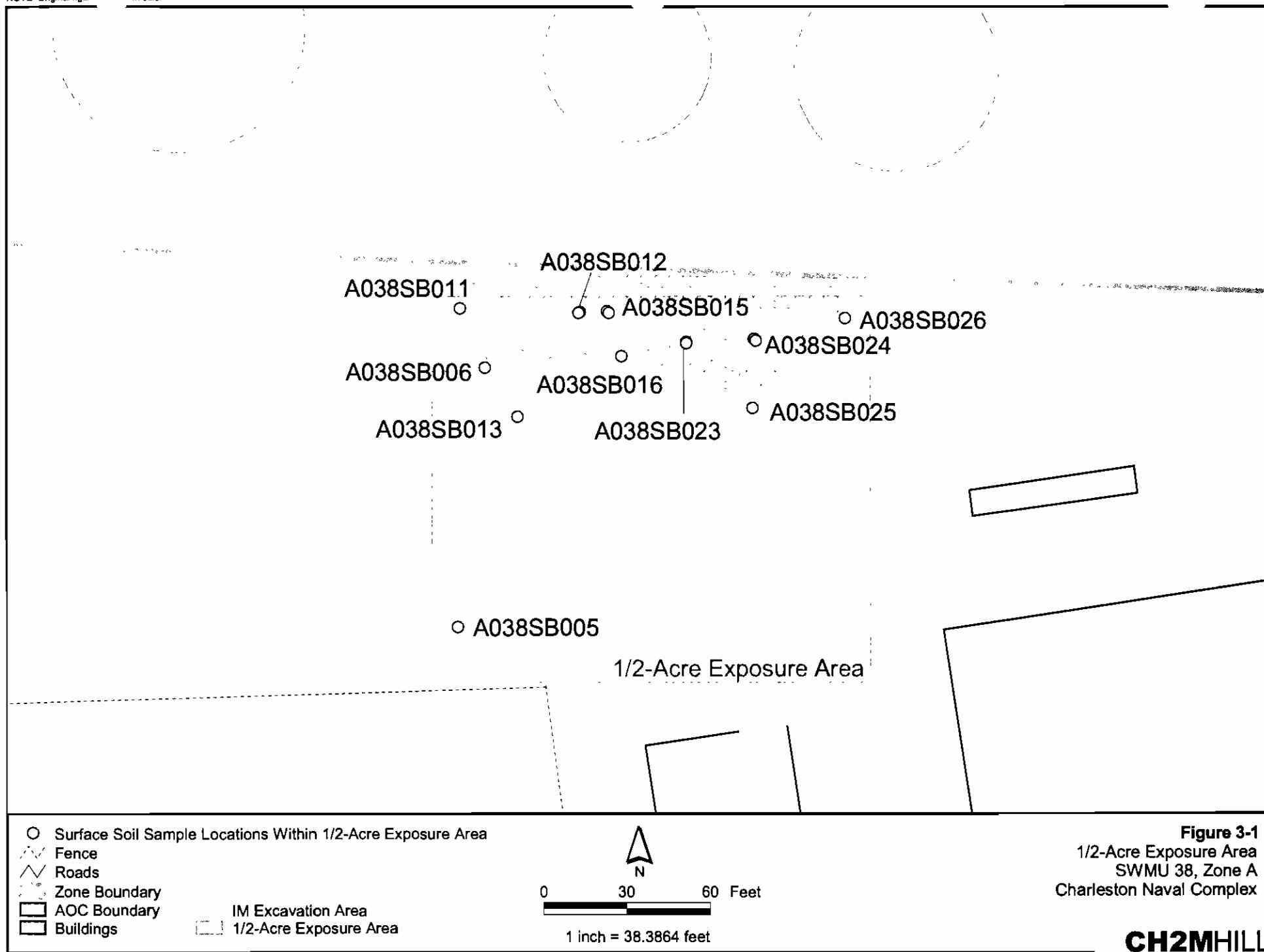


Figure 3-1
 1/2-Acre Exposure Area
 SWMU 38, Zone A
 Charleston Naval Complex

CH2MHILL

4.0 Post-Interim Measures Risk Assessment

Two soil IMs (one for pesticide-contaminated soil and one for PCB-contaminated soil), and one groundwater IM have been completed at SWMU 38. This section presents a residual risk evaluation for soil and groundwater at SWMU 38 under its current, post-IM condition. The risk assessment was conducted in accordance with RAGS, and EPA Region IV supplemental guidance (EPA, 1989 and EPA, 1994).

4.1 Selection of Residual COCs

4.1.1 Soil COCs

In order to assess the current potential risk at this site, PCBs are considered COCs. PCB values for soil samples within the target exposure area where excavation occurred were replaced with half the reporting limit values from the clean fill samples. Table 4-1 presents the data for DDD, DDE, DDT, and the PCBs Aroclor-1254 and Aroclor-1260, including both pre- and post-IM concentrations. The residual concentrations of pesticides and PCBs detected in soils were screened by comparing the maximum detected soil residual concentration against RBCs (HI=0.1 for noncarcinogens). The chemicals detected above RBCs are included for risk estimation.

All three pesticides (DDD, DDE and DDT) were below screening criteria, and are therefore not selected as COCs. Of the two PCBs (Aroclor-1254 and Aroclor-1260) that were originally selected as surface soil COCs at SWMU 38, only Aroclor-1260 was above RBC, and therefore is included as a COC for the risk assessment.

Tables 3-2 and 3-3 in the previous section presented the UCL₉₅ estimates for the two PCB constituents identified as soil COCs, as per SCDHEC recommendation. These COCs from soil are combined with groundwater COCs to estimate the total residual risk to a future potential residential receptor.

4.1.2 Groundwater COCs

A total of five shallow monitoring wells and one deep monitoring well located within SWMU 38 are used to monitor the groundwater quality at the site. The deep groundwater at the site did not have any detectable organic chemicals. The shallow groundwater at the site has detectable levels of pesticides only in the vicinity of where the pesticide-impacted soil and groundwater IMs were completed. These wells are screened within the shallow

1 saturated soil area where DDT degradation products were previously reported in soils at
2 these depths. Monitoring data collected from 1999 to 2002 were evaluated in this COC
3 selection. All groundwater data for these wells are included in this risk evaluation.

4 All of the detected pesticides occurred in wells A038GW001, A038GW005 (located directly
5 east of well A038GW001) and A038GW004 (located south of the other two wells). These
6 wells are within 20 to 30 feet from each other. A monitoring well located approximately 80
7 ft downgradient southeast (A038GW003) of the above three wells did not have detectable
8 levels of pesticides.

9 A separate and dilute groundwater chlorinated volatile organic chemical (CVOC) plume
10 has been identified near SWMU 38. The highest levels of CVOC constituents were detected
11 in well A038GW003, with trace levels detectable in A38GW001. This plume is likely an
12 extension of the CVOCs associated with SWMU 39.

13 A list of residual groundwater COCs was developed for SWMU 38-related groundwater
14 contamination. To estimate potential risks from exposures, COCs were identified based on
15 groundwater from all five wells, regardless of the source of their occurrence. The list of site-
16 related potential groundwater COCs carried forward in this human health risk assessment
17 (HHRA) includes:

- 18 • 4,4-DDD (wells A38GW001, A38GW004, and A38GW005)
- 19 • Heptachlor (A38GW001)
- 20 • Acetone (A38GW001, A38GW004, and A38GW005 – only in 7-day performance
21 sampling)

22 Of these three identified COCs, the only chemical consistently detected was DDD in wells
23 A38GW001 and A38GW004. Heptachlor is occasionally detected near detection limits in
24 well A38GW001, and could be related to the past pesticide disposal. The acetone detected
25 was associated with a single sampling event, during the 7-day post-IM monitoring, and is
26 likely an analytical artifact. The blanks from that sampling event did not have acetone,
27 therefore acetone was retained as a COC for the risk assessment.

28 Additionally, CVOCs were detected primarily in wells A38GW003, A38GW004, and
29 A38GW005, and less frequently at low levels in A38GW001. The highest levels of CVOCs
30 were found in A38GW003, and are believed to originate from the CVOC plume that is
31 currently being investigated at SWMU 39. All of the detected VOCs and pesticides were
32 screened during this COC selection regardless of potential origin, and the following

additional groundwater COCs were identified for risk assessment for the total COCs for the site groundwater.

- Cis-1,2-dichloroethene (Cis 1,2-DCE)
- Total-1,2-DCE
- Vinyl chloride

Table 4-1 includes a list of the COCs identified based on screening of maximum detected concentration of chemicals against RBCs (noncarcinogens at HI=0.1) values.

4.2 Toxicity Assessment

Toxicity factors were obtained from the Integrated Risk Information System (IRIS) website or Health Effects Assessment Summary Tables (HEAST, 1997), as appropriate. Table 4-2 lists the toxicity factors used in the risk calculations for groundwater COCs identified at SWMU 38 and the surrounding area. A separate slope factor was used in these risk estimations, as recommended by EPA for an adult versus child receptor (see Table 4-2).

4.3 Exposure Assessment

The soils at the site have been remediated and replaced with clean soils. Exposures to the site soils are assumed for future residential receptors for this evaluation using previously collected data from areas that were not excavated and clean soil areas using data based on clean fill material. The risks to exposure for a residential adult or child were evaluated using default exposure assumptions. Appendix C presents the exposure assumptions used in this risk assessment. A UCL₉₅ concentration of the residual soil concentrations is estimated for the exposure point concentration (EPC) for SWMU 38 soils.

There is no exposure to site groundwater at the present time. The future land use plans for this area of CNC, which is located next to the Hess Facility, include the possible development of a recreational area. Human receptor exposure is not anticipated under such future land use. For conservative future use evaluation, groundwater was evaluated for potable use by a future residential adult and a residential child. The exposure factors used were the default factors recommended by EPA for an ingestion pathway. Following EPA Region IV guidance, an inhalation exposure dose to VOCs was assumed to be equal to an ingestion dose. This assumption is likely to include other potential exposure route doses such as dermal contact during showering, as per EPA Region IV guidance.

Since each well has been monitored several times since 1999, and contaminant levels as a whole did not indicate a clear trend, a statistical upper-bound 95-percent confidence limit on the mean (UCL_{95}) was estimated for the EPC. Table 4-3 lists the estimated UCL_{95} concentration for all COCs identified in groundwater at and around SWMU 38.

4.4 Risk Characterization

Table 4-4 includes a summary of the excess lifetime cancer risk (ELCR) and the hazard index (HI) per exposure route and receptor. The details of the ELCR, hazard quotients (HQs), and HI for each COC are presented in Appendix C of this IM CR.

Residual risks from soil PCBs remaining in surface soil were estimated after the IM (recommended by SCDHEC) is implemented. Only Aroclor-1260 was detected above the RBC at the maximum detected concentration, and therefore is identified as a COC for ELCR estimation. This chemical is not identified with non-cancer effects (no RfD).

A separate set of ELCR and HI values were estimated for COCs present in groundwater due to past activities at SWMU 38. The CVOCs identified in groundwater at SWMU 38 are suspected to be associated with SWMU 39, as the highest concentrations of CVOCs are located in the more southerly portion of the site. This general area is being investigated/remediated for CVOCs associated with SWMU 39.

4.4.1 Risks and Hazard Index from SWMU 38-Related Chemicals

The ELCR for a future residential adult is estimated at 5.6×10^{-6} , primarily due to DDD and heptachlor, at the UCL_{95} levels (see Table 4-4) in groundwater. The soil ELCR is less than 1 in a million level. The detected heptachlor concentration, at a maximum of $0.03 \mu\text{g/L}$, is low compared to a detection limit of $0.05 \mu\text{g/L}$, and it is below the heptachlor MCL of $0.4 \mu\text{g/L}$. DDD does not have an MCL. DDD was selected as COC because the RBC is $0.28 \mu\text{g/L}$. The total HI is 0.064, which is much lower than the target value of 1.0.

The ELCR for a future residential child is estimated at 2.3×10^{-6} , due to the same chemicals as for an adult, although no single chemical presented a risk above a 1 in a million level (see Appendix C). A separate carcinogenic slope factor is proposed by EPA for the future residential child scenario, which was used to estimate the risks. The total HI for a child was estimated at 0.15, which is below the target HI of 1.0.

None of the site-related chemicals in groundwater exceeded the MCL, and the risks that were estimated for combined soil and groundwater from site-related chemicals are within

the target limits, and are considered acceptable for a future unrestricted (i.e., residential) land use.

4.4.2 Risks and Hazard Index from All Chemicals in Groundwater in the Vicinity of SWMU 38

The ELCR for a residential adult is estimated at 1.1×10^{-4} , primarily due to vinyl chloride (1.1×10^{-4}), with minor contributions from DDD and heptachlor (at 10^{-6} levels). The HI for an adult is 0.19, which is well below the target level of 1.0.

The ELCR for a residential child is estimated at 7.8×10^{-5} , due to vinyl chloride. No other chemicals contributed above a 1 in a million level. The HI is estimated at 0.44, which is below the target level of 1.0.

Vinyl chloride was detected above its MCL of $2 \mu\text{g/L}$ in three wells (A38GW001, A38GW003, and A38GW004). No other CVOCs were detected above their MCLs or RBCs in any of the SWMU 38 wells.

4.5 General Considerations

Chlorinated pesticides, particularly DDT and its degradation products, are nearly insoluble in water. However, filtered samples are typically not collected, as the chemicals, being highly polar, tend to adhere to glass and other surfaces of sampling equipment. It is possible that the observed pesticide concentrations are due to the presence of small amounts of soil particulates, rather than due to the pesticides being present in groundwater in a truly dissolved state. This is supported by the absence of any detectable pesticides in wells outside the previous source area (i.e., subsurface soil pesticide detection area). Except for one low-level heptachlor detection, which was below the detection limit in the deep well, all other deep well samples were non-detect for chlorinated pesticides, indicating that these pesticides are not migrating downward.

4.6 Summary and Recommendations

The estimated overall site risks and HI due to SWMU 38 related chemicals are well within the target risk levels of 1 to 100 in a million (10^{-6} to 10^{-4}), and the HI is below 1.0 for both residential adults and children.

The risks due to chemicals present in groundwater not related to SMWU 38 (e.g., vinyl chloride) are above the range of acceptable risks. A nearby site (SWMU 39) is known to have relatively higher levels of these solvents and is being investigated/remediated for

- 1 CVOCs, which is the likely source of the low-level CVOCs detected at SWMU 38. Therefore,
- 2 as the risks are within acceptable limits, SWMU 38 is recommended for NFA status.
- 3 Groundwater CVOCs will be addressed as part of the SWMU 39 investigation.

TABLE 4-1
 Selection of COCs in Soil and Groundwater for Residual Risk Assessment
Interim Measure Completion Report, SWMU 38, Zone A, Charleston Naval Complex

Chemical	Samples*	Detects	NonDetects	Min Detect	Max Detect	Avg Detect	Mean	Min nondetect	Max nondetect	RBC	COC (Y/N)
Surface Soil (mg/kg)											
PCB, Aroclor-1260	11	5	6	0.018	0.72	0.265	0.128	0.008	0.041	0.32	Yes
PCB, Aroclor-1254	11	2	9	0.049	0.064	0.057	0.020	0.007	0.041	0.32	No
DDD	16	7	9	0.0016	0.29	0.111	0.049	0.0013	0.00265	2.7	No
DDE	16	9	7	0.0068	0.58	0.183	0.103	0.0013	0.00265	1.9	No
DDT	16	8	8	0.0210	1.70	0.590	0.297	0.0013	0.015	1.9	No
Groundwater (µg/L)											
4,4-DDD	16	10	6	0.046	1.4	0.578	0.377	0.04	0.05	0.28	Yes
4,4-DDE	14	2	12	0.024	0.034	0.029	0.039	0.04	0.05	0.2	No
4,4-DDT	14	1	13	0.022	0.022	0.022	0.039	0.04	0.05	0.2	No
Gamma-Chlordane	14	1	13	0.0078	0.0078	0.008	0.020	0.02	0.026	0.19	No
Alpha-Chlordane	14	1	13	0.019	0.019	0.019	0.020	0.02	0.026	0.19	No
Endosulfan, sulfate	14	1	13	0.022	0.022	0.022	0.039	0.04	0.05	22	No
Endrin	14	1	13	0.021	0.021	0.021	0.039	0.04	0.05	1.1	No
Endrin Ketone	14	1	13	0.02	0.02	0.020	0.039	0.04	0.05	1.1	No
Heptachlor	14	3	11	0.0094	0.015	0.012	0.019	0.02	0.026	0.015	Yes
Acetone	17	3	14	10	1,200	596.7	109.1	2.5	5	61	Yes
Cis-1,2-DCE	17	9	8	0.66	6.4	3.4	3.0	2.5	2.5	6.1	Yes
Total 1,2-DCE	17	9	6	0.66	8.3	4.5	3.7	2.5	2.5	5.5	Yes

TABLE 4-1

Selection of COCs in Soil and Groundwater for Residual Risk Assessment
Interim Measure Completion Report, SWMU 38, Zone A, Charleston Naval Complex

Chemical	Samples*	Detects	NonDetects	Min Detect	Max Detect	Avg Detect	Mean	Min nondetect	Max nondetect	RBC	COC (Y/N)
Groundwater (µg/L)											
Trans 1,2-DCE	17	7	8	0.62	2.3	1.4	2.0	2.5	2.5	12	No
Methyl Ethyl Ketone (2-butanone)	17	1	16	94	94	94.0	9.9	2.5	5	190	No
Trichloroethene	17	1	16	0.97	0.97	0.97	2.4	2.5	2.5	1.6	No
Vinyl Chloride	17	9	8	0.51	25	9.4	7.1	2.5	5	0.015	Yes

Groundwater data included are from 1999 to 2002, which was multiple sampling rounds of the same wells.

Soil samples were those remaining at the site after excavation and replaced with clean fill

* - Samples for groundwater include multiple rounds of sampling for the same wells

TABLE 4-2
 Toxicity Factors Used in Risk Estimations
Interim Measure Completion Report, SWMU 38, Zone A, Charleston Naval Complex

Chemical	Oral Slope Factor (kg-day/mg)	Inhalation Slope Factor (kg-day/mg)	Chronic Oral Reference Dose (mg/kg-day)	Chronic Inhalation Reference Dose (mg/kg- day)	Source
Aroclor-1260	2.00E+00	2.00E+00	NA	NA	IRIS
4,4-DDD	2.40E-01	NA	NA	NA	IRIS
Heptachlor	4.50E+00	4.50E+00	5.00E-04	NA	IRIS
Acetone	NA	NA	1.00E-01	NA	IRIS
Cis-1,2-DCE	NA	NA	1.00E-02	NA	HEAST
Total 1,2-DCE	NA	NA	9.00E-03	NA	HEAST
Vinyl Chloride - Child	1.40E+00	3.00E-02	3.00E-03	2.80E-02	IRIS
Vinyl Chloride - Adult	7.20E-01	1.50E-02	3.00E-03	2.80E-02	IRIS

IRIS = Integrated risk information system (IRIS), EPA, 2002 (webaddress: <http://www.epa.gov/iris/>)

HEAST = Health Effects Assessment Summary Tables (HEAST). EPA-540-R-97-036, USEPA. 1997

NA = A value not available

TABLE 4-3
UCL₉₅ Estimates for COCs Identified in Soil and Groundwater at SWMU 38
Interim Measure Completion Report, SWMU 38, Zone A, Charleston Naval Complex

Chemical	Samples	Detects	NonDetects	Min Detect	Max Detect	Avg Detect	Mean	Min nondetect	Max nondetect	W-Test	UCL95 normal	UCL95-log-normal	UCL95 nonparm	UCL95 nonaram (bootstrap)	RBC
Surface Soil (mg/kg)															
PCB, Aroclor-1260	11	5	6	0.018	0.72	0.26454	0.12756364	0.008	0.0405	NONPARAMETRIC	0.72	0.72	0.008	0 238	0.32
Groundwater (µg/L)															
4,4-DDD	16	10	6	0.046	1.4	0.578	0.38	0.04	0.05	NONPARAMETRIC	0.6	1.3	0.04	0.57	0.28
Heptachlor	14	3	11	0.0094	0.015	0.0	0.02	0.02	0.026	NONPARAMETRIC	0.0	0.0	0.015	0.02	0.015
Acetone	17	3	14	10	1200	596.7	109.12	2.5	5	NONPARAMETRIC	242.0	177.9	5	231	61
Cis-1,2-DCE	17	9	8	0.66	6.4	3.4	2.98	2.5	2.5	LOGNORMAL	3.6	4.0	1.7	3.61	6.1
Total 1,2-DCE	17	9	6	0.66	8.3	4.5	3.69	2.5	2.5	NONPARAMETRIC	4.8	5.7	2.3	4.67	5.5
Vinyl Chloride	17	9	8	0.51	25	9.4	7.05	2.5	5	LOGNORMAL	10.0	13.7	2.5	9.95	0.015

TABLE 4-4
 Residual Contaminant Risk Summary for Soil and Groundwater at SWMU 38
Interim Measure Completion Report, SWMU 38, Zone A, Charleston Naval Complex

Risks from Chemicals Associated with SWMU 38									
ELCR						HI			
Receptor	Ingestion	Dermal	Inhalation	Total	Risk Driver	Ingestion	Inhalation	Total	Hazard Driver
Soil									
Residential Adult	7.46E-07	8.23E-08	NA	8.3E-07	None	--	--	--	None
Residential Child	5.446E-07	3.70E-08	NA	5.8E-07	None	--	--	--	None
Groundwater									
Residential Adult	3.4E-06	NA	1.372E-06	4.8E-06	DDD, Heptachlor	0.06	--	0.064	None
Residential Child	1.258E-06	NA	5.055E-07	1.8E-06	None	0.15	--	0.15	None
Total adult ELCR	4.2E-06	8.2E-08	1.4E-06	5.6E-06	DDD, Heptachlor	0.06	--	0.06	
Total Child ECLR	1.8E-06	3.7E-08	5.1E-07	2.3E-06	None	0.15	--	0.15	
Risks from All Chemicals Detected in Groundwater near SWMU 38									
ELCR					HI				
Receptor	Ingestion	Dermal	Inhalation	Total	Risk Driver	Ingestion	Inhalation	Total	Hazard Driver
Residential Adult	1.1E-04		1.4E-06	1.1E-04	Vinyl chloride, DDD, Heptachlor	0.18	0.01	0.19	None
Residential Child	7.759E-05		5.055E-07	7.8E-05	Vinyl chloride	0.42	0.02	0.44	None

ELCR - Excess Lifetime Cancer Risk

HI = Hazard Index

Risk and Hazard Drivers are those chemicals contributing an ELCR above 1E-6 and and HQ greater than 1, respectively

5.0 Recommendations

The *Interim Measure Work Plan, In Situ Chemical Oxidation of DDD in Groundwater, SWMU 38, Zone A* was submitted on December 20, 2001, by CH2M-Jones. SCDHEC commented on the IM WP and granted approval of the IM WP on February 13, 2002. Responses to SCDHEC's comments on the IM WP are provided in Appendix A.

In addition to the IM for groundwater, a prior IM was conducted by CH2M-Jones at SWMU 38 to remove PCB-impacted soil. The IM CR for that IM was submitted on June 10, 2002. SCDHEC reviewed the IM CR for soil removal and issued comments on July 11, 2002. Responses to SCDHEC's comments on the PCB-impacted soil removal IM CR are also provided in Appendix A.

This groundwater IM CR documents the IM conducted at SWMU 38, presents a final post-IM residual risk evaluation for the site soil and groundwater, and presents the analytical data used to develop it.

Because the data support the conclusion that soil and groundwater at SWMU 38 do not present an unacceptable risk to human health or the environment, SWMU 38 is recommended for NFA status.

1 6.0 References

- 2 CH2M-Jones Inc. *Corrective Measures Study Work Plan – Source Area Delineation, SWMU 38,*
3 *Zone A, Charleston Naval Complex.* Revision 0. February 2001a.
- 4 CH2M-Jones Inc. *Interim Measure Work Plan, In-Situ Chemical Oxidation of DDD in*
5 *Groundwater, SWMU 38, Zone A, Charleston Naval Complex.* Revision 0. December 2001b.
- 6 CH2M-Jones Inc. *Interim Measure Work Plan –Soil Removal, SWMU 38, Zone A, Charleston*
7 *Naval Complex.* Revision 0. March 2002a.
- 8 CH2M-Jones Inc. *Interim Measure Completion Report, Soil Removal, SWMU 38, Zone A,*
9 *Charleston Naval Complex.* Revision 0. June 2002b.
- 10 EnSafe Inc. *Zone A RCRA Facility Investigation Report, NAVBASE Charleston.* North
11 *Charleston, South Carolina.* Revision 0. 1998.
- 12 U.S. Environmental Protection Agency. Integrated Risk Information System (IRIS)
13 <http://www.epa.gov/iris/>. 2001.
- 14 U.S. Environmental Protection Agency. Health Effects Assessment Summary Tables
15 (HEAST). EPA-540-R-97-036. 1997.

Engineering Comments Prepared by Jerry Stamps

SCDHEC General Comments:

1. The following comments are intended to notify the Navy and CH2M-Jones of the issues that must be resolved prior to receiving a No Further Action determination from the Department. These comments are not intended to prevent the implementation of this Interim Measure.

CH2M-Jones Response 1:

Comment noted.

2. This IM Work Plan states that the oxidation reaction with DDD will be similar to that of the oxidation of benzene. However, given the chemical dissimilarities between DDD and benzene, the Department is concerned about the potential break down products as a result of the reaction. It is the Department's understanding that GeoCleanse has previous experience using the Fenton's reagent technology to successfully remediate areas of pesticide contamination. Please provide the Department with historical accounts of the effective use of this technology at other similar sites. This topic was discussed in the February 12, 2002 BCT meeting.

CH2M-Jones Response 2:

The IM WP states that "the oxidation pathways for DDD and DDT are not well known, but are anticipated to be very similar to that of benzene." This conclusion is based on the observation that the hydroxyl radical first attacks the double-bonded ring structure of benzene. The structure of DDD and DDT are similar to benzene in that they are composed of aromatic rings. The hydroxyl radical would be expected to attack the ring structure of DDD and/or DDT in the same manner as benzene. Once fission of the aromatic ring occurs, complete mineralization would be expected by the same mechanism as well.

Little experience is available with regard to oxidation of DDD and DDT with Fenton's reagent. CH2M-Jones did evaluate similar compounds (specifically methoxychlor), and concluded that although not proven, Fenton's reagent showed promise in reducing DDD and DDT concentrations at SWMU 38. The results of this evaluation were presented in the Technical Memorandum Oxidation of DDD by Fenton's Reagent, Interim Measure at SWMU 38, Zone A, Charleston Naval Complex prepared by CH2M-Jones and submitted to SCDHEC on February 21, 2002. Additionally, DDT, and dieldrin, had been reported to have been successfully remediated in soil by William R. Mahaffey. The summary of his work was attached to the technical memorandum.

3. Though this IM work plan is intended to address the pesticides in groundwater, it evident from this work plan that the chemical oxidation is intended to remediate pesticides present in both the groundwater and subsurface soils. The confirmation

samples collected by the DET (samples 038S03001 and 038S03101) demonstrated contamination well above the SSLs for DDD and DDT. Upon completion of the interim measure, the Department recommends collecting subsurface soil samples at these same locations and depths, along with samples just below the depth of the DET samples, to evaluate the effect of the chemical oxidation on these contaminants bound to the subsurface soils. Please be advised that full VOC analysis in addition to the pesticide analysis will be required given the unknowns concerning the breakdown of DDD, DDE, and DDT as a result of the oxidation process.

CH2M-Jones Response 3:

As stated, the goal of this IM was to reduce the concentrations of DDD and DDT in groundwater. Due to the non-selective nature of the chemical oxidation process, organic compounds contacted by the hydroxyl radical will undergo oxidation regardless of whether adsorbed to soil or dissolved in groundwater. Therefore, reductions in soil and groundwater concentrations were expected to result from this IM.

CH2M-Jones collected the samples recommended by SCDHEC. The results were discussed in the IM CR. As reported, none of the detected compounds (VOCs or pesticides) were detected above their respective generic SSLs (DAF=10 for pesticides and DAF=1 for VOCs).

4. CH2M-Jones collected 10 samples from 5 locations to bracket the subsurface soil contamination. At each location, a sample was collected above (4 – 4.5 ft bg) and below (5 – 5.5 ft bg) the water table. According to the well log in Appendix A, a brown sand exists down to 6 ft bg. Considering this well was installed in an area that was back-filled by the DET, one must conclude that this brown sand is the fill material used by the DET. Since the deepest sample was collected at approximately 5.5 ft bg, it appears that the fill material may have been sampled rather than native soils. Based upon photographs in the DET IM Completion Report, the fill material appears markedly different from the native soils. Therefore, the distinction between the fill and the native soils should have been relatively easy for the field personnel conducting the sampling. Please document that the native soils were sampled rather than the fill material.

CH2M-Jones Response 4:

The DET reported the depth of their IM excavation to be 4 to 5 ft bls. The field team was aware of the goals associated with this sampling effort prior to arriving at the site. They indicated that all subsurface soil samples collected for sampling activity appeared to be native soil, not backfill.

SCDHEC Specific Comments:

5. Section 3.7, Page 3-6

According to the IM WP, performance monitoring will begin seven days and thirty days

after injection. The Department recommends collecting samples immediately prior to injection to serve as baseline for comparison to accurately evaluate the effectiveness of this interim measure. This baseline sampling would also serve to evaluate the existing natural conditions to determine which reagents will be necessary (i.e., the addition of acids to adjust the pH to ideal range for Fenton's reagent, addition of iron, etc.).

CH2M-Jones Response 5:

The baseline samples were collected as recommended and the analytical results are discussed in the IM CR.

6. Section 5.0

Though outside the scope of this Interim Measure, the PCB contamination must be addressed prior to receiving a No Further Action decision from the Department.

CH2M-Jones Response 6:

The PCB contamination has been addressed subsequent to SCDHEC issuing comments to this IM CR. An IM CR was submitted on June 12, 2002 for the PCB-impacted soil removal. Comments were issued on July 11, 2002. Responses to those comments are in Appendix A.

Hydrogeology Comments Prepared by Paul Bergstrand

1. Page 1-1, Lines 9-10

This document states that the Naval Detachment (DET) interim measure (IM) excavation of pesticide contaminated soils was four to five feet deep. However, the replacement monitoring well log in this document indicates a gravel layer emplaced from 6 to 7 feet below the surface. This implies that the DET excavation was actually much deeper than reported. Therefore it is likely that some or all of the subsurface soil samples reported in this document were actually collected from the materials used to backfill the excavation. This section of the workplan does not require revision, however the topic must be addressed in the report of findings.

CH2M-Jones Response 1:

See the response to Engineering Comment #4.

2. Page 1-1, Lines 26-27

This section of the document states that "The results of subsurface soil sampling..... did not identify pesticide contaminated soils." Review of the data provided in this document indicates that low levels of pesticide contaminated soils were detected in subsurface soil samples. This section of the workplan does not require revision.

CH2M-Jones Response 2:

The referenced statement should have read "The results of subsurface soil sampling conducted at the same time as the well installation did not identify pesticide-contaminated soils above appropriate screening criteria."

3. Page 2-2, Lines 11 – 22

In addition to comment number 1 above, the monitoring well log indicates the water table at installation on 24 September 2001 was at 2.5 feet below land surface. The monitoring well log depth to water correlates well with reported groundwater elevations. However, since the subsurface soil samples were collected just above and just below the water table at 4.5 and 5.5 feet respectively on 9 October 2001, the water table must have dropped 2.5 feet in two weeks. This topic must be addressed in the report of findings.

CH2M-Jones Response 3:

Water levels listed on the well logs are generally made while drilling and can easily be off by a foot or two. Installation of the well may have impacted the observed water level in the well when the water level measurement was made.

Also the subsurface samples were collected with a Geoprobe and the depth to water was determined based on observations of the extracted soil column. Water could have drained from the soil column during extraction of the Geoprobe, resulting in a depth to water estimation that is deeper than actually existed. Therefore the difference in water levels over the 2-week interval may not be as dramatic as it appears.

4. Page 3-3, Lines 16 – 21.

This document states as a fact that “The oxidation pathways for DDD and DDT are not well known, but are anticipated to be very similar to that of benzene.” This uncertainty is noted. This topic and the effectiveness of oxidation on pesticides must be addressed in the report of findings.

CH2M-Jones Response 4:

The rationale behind the conclusion that the oxidation pathway is expected to be similar to that of benzene was presented in the Technical Memorandum Oxidation of DDD by Fenton’s Reagent, Interim Measure at SWMU 38, Zone A, Charleston Naval Complex prepared by CH2M-Jones and submitted to SCDHEC on February 21, 2002. Additionally, DDT, and dieldrin, had been reported to have been successfully remediated in soil by William R. Mahaffey. The summary of his work was attached to the technical memorandum.

The effectiveness of the Fenton’s reagent chemical oxidation process on the pesticide DDD is discussed in the IM CR.

5. Page 3-3, Lines 23 – 29.

The workplan states “Factors that affect contaminant treatment include effective radius of influence, sustainable injection rate, oxidation efficiency, and the effect of site-specific geological and hydrogeological conditions on the overall treatment. Because of the small area of impacted environmental media at SWMU 38, these factors are not expected to limit treatment at the site.” The Navy should note that the workplan does not contain any site specific data in regards to the “Factors that affect contaminant treatment...” Also, the Navy should note that the extent of the contaminated soil and groundwater has not been fully delineated. This section of the workplan does not require revision, however these issues must be addressed in the report of findings.

CH2M-Jones Response 5:

CH2M-Jones does not agree that the extent of pesticide-impacted soil and groundwater have not been delineated. Section 2 of the IM WP describes the maximum area potentially exceeding the SSL and the rationale for its

determination. Because of the small area of DDD-impacted environmental media and the proximity of injection points to one another, the factors that generally limit treatment were not considered significant at this site. Therefore, extended discussion of these issues was not provided.

6. Page 3-4, Lines 2 – 3.

This section of the workplan references Figure 3-2 for the proposed locations of the three injectors. Figure 3-2 indicates that Injector Well #1 is 7 feet downgradient of the most contaminated subsurface soil sample. The workplan does not explain how the injected oxidant will migrate upgradient from the injection point. This topic must be addressed in the report of findings.

CH2M-Jones Response 6:

The chemical oxidation process is exothermic and the products of the reaction are carbon dioxide and oxygen. Additionally the reagents are injected under pressure. This results in an increase in subsurface pressure. This pressure increase forces the oxidant radially outward from the injection point. The radius of influence from the injection point is dependant on injection parameters and subsurface geologic conditions. The relatively flat hydraulic gradient in the area was not expected to significantly impact the radius of influence at SWMU 38.

7. Page 3-4, Lines 5 – 8.

This section of the work plan addressed the 7 to 10 foot depth of the three injectors. The workplan states “This depth is considered to be appropriate because the DDD and DDT are not expected to migrate significantly below the level of the water table, which was encountered at approximately 4 feet below land surface during the DET’s IM at SWMU 38.” The workplan has not considered the effects of a co-solvent, such as the petroleum fuels the Navy mixed with the pesticides, on the subsurface migration of the various pesticides. Also, the workplan does not explain how the injected oxidants will migrate from 7 to 10 feet below land surface to the approximate 4 foot water table where the DDD and DDT are expected to be found. This topic must be addressed in the report of findings.

CH2M-Jones Response 7:

While not specifically addressed, the use of co-solvents was considered. The analytical data did not indicate the presence of cosolvents that would be expected to increase the leachability of the pesticides.

See comment #6 for an explanation of radius of influence.

8. Page 3-5, Lines 8 – 9

This section states that the injection wells will be constructed to withstand elevated temperatures and pressures. The durability of the installed and the proposed PVC monitoring wells at this site have not been addressed in regards to elevated temperatures and pressures. This topic must be addressed in the report of findings.

CH2M-Jones Response 8:

The monitoring wells are remote enough to not be significantly affected by the elevated temperatures. Monitoring wells are kept open during the injection of oxidants to provide pressure relief for liberated carbon dioxide and oxygen.

9. Page 3-6, Line 4.

This section of the workplan states that "Performance groundwater samples will be collected after seven and 30 days." Because this is a new and innovative remedial technology, the oxidation pathway is not known, and the full extent of contamination is not defined, the potential exists for rebound of pesticide contamination in groundwater. In addition to the seven and 30 day samples, the Navy should collect performance samples six months after the injection from all site monitoring wells, including the deep monitoring well, for evaluation. Performance groundwater samples should be analyzed for Pesticides, VOCs, SVOCs and the Geo-Cleanse hydrogen peroxide solution.

CH2M-Jones Response 9:

As requested the 7-day and 30-day performance samples were analyzed for VOCs, SVOCs, and pesticides. Hydrogen peroxide is highly unstable and will decompose within several hours of injection. Therefore analyzing the samples for hydrogen peroxide is not necessary.

Further sampling will be considered as part of the final remedy for the site.

10. Page 5-1, Lines 4 – 5.

The document states that "If the results indicate that the IM was successful, a recommendation for no further action (NFA) for groundwater will be provided." The Navy should not separate a SWMU or AOC into soil and groundwater components in regards to a recommendation for NFA. Regarding site soil contamination, correspondence dated 2 August 2001 (Scaturo to Daniell) clearly informs the Navy that the extent of PCB contamination exceeding 1 mg/kg has not been defined to the east and southeast of sample location A038SB012. Regarding groundwater contamination, the

one and only deep monitoring well reported heptachlor in the sampling event of March 1999. How the pesticide contamination migrated to this deep well has not been addressed and the deep well has not been sampled for pesticides since March of 1999. A decision for NFA can only be made once the full extent of contamination has been determined and addressed. This section of the workplan does not require revision, however these issues must be addressed in the report of findings.

CH2M-Jones Response 10:

The PCB contamination has been addressed subsequent to SCDHEC issuing comments to this IM CR. An IM CR was submitted on June 12, 2002 for the PCB-impacted soil removal. Comments were issued on July 11, 2002. Responses to those comments are presented in Appendix A.

Heptachlor was detected in a single sample (038GWC1D01) at a concentration of 0.013 J ug/L. The reported concentration is estimated and near the detection limit as indicated by the "J" qualifier. The reported concentration is also below the MCL of 0.4 ug/L. Heptachlor was not detected in the previous four samples collected from monitor well A038GW01D. Additionally, heptachlor was not detected in any of the three samples collected from A038GW01D during the IM. Based on these data, the single detection of heptachlor below its MCL does not warrant further investigation or remedial action.

11. Appendix A

The well construction log for A038GW001 does not include the name and License number of the SC Registered well driller. Please provide this information in the report of findings.

CH2M-Jones Response 11:

Attached is a replacement well construction log with the requested information included.

12. Appendix B

The chain of custody forms were not included with the data summary. Please provide this information in the report of findings.

CH2M-Jones Response 12:

Attached are the chain of custody forms.

13. Appendix C

This section contains the Data Validation Summary for the soil and groundwater samples collected in September and October 2001. Page 9 of this summary states that "No data was rejected for the sampling event." This statement appears to be contradicted in the data summary tables of Appendix B, particularly for samples A038SB01701, A038SB01701DL, and A038GW001L1. Please address this apparent contradiction in the report of findings.

CH2M-Jones Response 13:

The statement in the 'Rejected Data' portion of the Data Validation Summary was incorrect in stating that "No data was rejected for the sampling event." It should have read "All of the rejected data listed in Attachment 1 were associated with re-runs and dilutions (you can only have a single valid result per parameter per sample). No other data were rejected such that there is not a valid result for that parameter in each sample."

The flagging for sample 038GW001L1 has been adjusted to more accurately reflect what occurred with the sample. Sample 038GW001L1 had been incorrectly flagged as "R-SS" instead of "R-RE". The sample had been analyzed with QC problems (surrogate failure), and then reanalyzed as 038GW001L1RE without QC problems. One set of data had to be rejected since there can only be one value per parameter per sample. The reanalysis was chosen as the better data set. The original sample should have therefore been flagged "R-RE" which indicates that the data was rejected in favor of a better set of reanalyzed data. Attached is an updated Attachment 1.

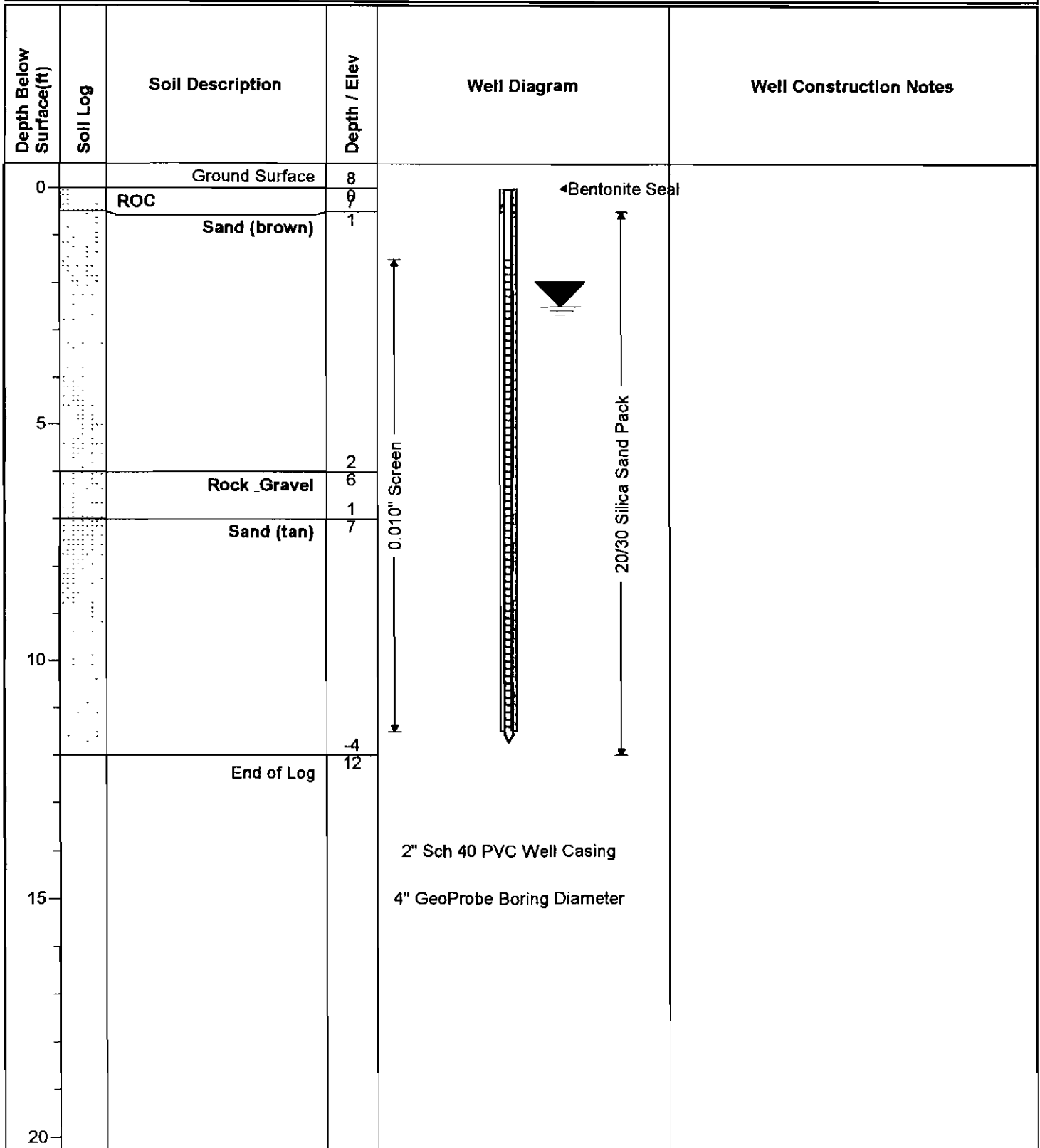


Well Number: A038GW001

Sheet: 1 of 1

Client: Navy
Project: CNC
Location: North Charleston, South Carolina
Project Number: 158814

Driller: Columbia Technologies - License No. 1485
Drilling Method: Geoprobe
Sampling Method:
Logged by: Darryl Gates
Start/Finish Date: 9/24/2001



HILL Chain of Custody/ Laboratory Analysis Form

COC Tracking #: **ZA038-092601-01**

Page 1 of 2

Laboratory: STL (Savannah, GA)	
Project Name: Charleston Navy Complex	Site Name: Zone A, SWMU 38
Project Number: 158814.PM.04	TAT: 7 day results, 14 day Package
Project Manager: Tom Beisel/ATL	Level: Level 3
Address: GNV: 3011 SW Williston Rd., Gainesville, FL 32605	
ATL: 115 Perimeter Center Place NE, Suite 700, Atlanta, GA 30346-1278	
Send Report To: see last page of COC	EDD: CNC format

Lab Batch/SDG:

CNC 33
CNC 34

Sample ID	Sample Description	Depth		Date & Time Collected	Matrix	# of c	PCBs	Pestic (SW80	PCBs	Pestic (SW80								Comments
		Begin	End															
038SB01501	A038SB015	0	1	9-27-01/1350	SO	1	X											
038SB01601	A038SB016	0	1	9-27-01/1355	SO	1	X											
038CB01601	A038SB016	0	1	9-27-01/	SO	1	X											
038EB015L1	A038EB015			9-27-01/1400	SQ	2			X									EB
038SB01701	A038SB017	0	1	9-27-01/1345	SO	1		X										
038SB01803	A038SB018			9-27-01/1410	SO			X										
038SB01804	A038SB018			9-27-01/1415	SO			X										
038SB01903	A038SB019				SO			X										
038SB01903MS	A038SB019				SO			X										MS
038SB01903SD	A038SB019				SO			X										MSD
038SB01904	A038SB019				SO			X										
038SB02003	A038SB020				SO			X										
038SB02004	A038SB020				SO			X										
038SB02103	A038SB021				SO			X										
038SB02104	A038SB021				SO			X										
038SB02203	A038SB022				SO			X										
038SB02204	A038SB022				SO			X										
038EB017L1	A038EB017			9-27-01/1405	SQ	2				X								EB
038GW001L1	A038GW001			9-27-01/1105	WG	2				X								
038EW001L1	A038EW001			9-27-01/1110	WQ	2				X								EB

RUSH

Sampled By: Chris Blundy	Date/Time: 9-27-01	Relinquished by: Chris Blundy	Date/Time: 9-27-01/1600
Additional Samplers: Barryl Gates			
Received By Lab: C. Vasquez	Date/Time: 9-28-01 8:55	Relinquished by:	Date/Time:
Received By:	Date/Time:	Shipped Via: UPS FedEx Hand Other Tracking#:	
Remarks: FAX results to Tom Beisel & Herb Kelly.		Temperature:	

Receipt Exceptions:

0111251 *51-112442*

Laboratory: STL (Savannah, GA)		Project Name: Charleston Navy Complex		Site Name: Zone A, SWMU 38	
Project Number: 158814.PM.04		TAT: 7 day results, 14 day Package			
Project Manager: Tom Beisel/ATL		Level: Level 3			
Address: GNV: 3011 SW Williston Rd., Gainesville, FL 32605					
ATL: 115 Perimeter Center Place NE, Suite 700, Atlanta, GA 30346-1278					
Send Report To: see last page of COC		EDD: CNC format			
Sample ID	Sample Description	Depth Begin End	Date & Time Collected	Matrix	Comments
038SB01501	A038SB015		sampled previously	SO	
038SB01601	A038SB016		sampled previously	SO	
038CB01601	A038SB016		sampled previously	SO	
038EB015L1	A038EB015		sampled previously	SQ	
038SB01701	A038SB017		sampled previously	SO	
• 038SB01802 4	A038SB018	4 4.5	10-09-01 / 1020	SO 1	
• 038SB01804 6	A038SB018	5.5 6	10-09-01 / 1025	SO 1	
• 038SB01902 4	A038SB019	4 4.5	10-09-01 / 1010	SO 1	
038SB01902MS	A038SB019	4 4.5	10-09-01 / 1010	SO 1	MS 10/10/01
038SB01902SD	A038SB019	4 4.5	10-09-01 / 1010	SO 1	MSD
• 038SB01904 6	A038SB019	5.5 6	10-09-01 / 1015	SO 1	
• 038SB02002 4	A038SB020	4 4.5	10-09-01 / 0955	SO 1	
• 038SB02004 6	A038SB020	5.5 6	10-09-01 / 1000	SO 1	
• 038SB02102 4	A038SB021	4 4.5	10-09-01 / 0935	SO 1	
• 038SB02104 6	A038SB021	5.5 6	10-09-01 / 0940	SO 1	
• 038SB02203	A038SB022	4 4.5	10-09-01 / 0920	SO 1	
• 038SB02204	A038SB022	5.5 6	10-09-01 / 0925	SO 1	
• 038EB017L1	A038EB017		10-09-01 / 1045	WG 2	EB
038GW001L1	A038GW001		sampled previously	WG	
038EW001L1	A038EW001		sampled previously	WQ	

Lab Batch/SDG:

CNC 39

Sampled By: Darryl Gates

Date/Time: 10/9/01 / As noted

Relinquished by: Darryl Gates

Date/Time: 10/9/2001 / 1700

Additional Samplers: Chris Blundy

Received By Lab: R. D. H.

Date/Time: 10/10/01 9:07

Relinquished by:

Date/Time:

Received By:

Date/Time:

Shipped Via: UPS FedEx Hand Other Tracking#:

Remarks: FAX results to Tom Beisel & Herb Kelly.

Temperature:

51-16625

Reports

Receive Exceptions:

Attachment 1 - Chained Qualifiers and Results
Zone A, SWI 3 - Data Validation

SDG	Sample ID	Lab Sample ID	Test	Parameter	Analysis Method	Parameter	Lab Result	Lab Qual	Final Result	Final Qual	Units	Reasons
CNC33	038SB01501	S116351*1	SO	PCB	SW8082	PCB-1254 (AROCHLOR 1254)	2400	=	2400	J	ug/kg	2C
CNC33	038SB01501	S116351*1	SO	PCB	SW8082	PCB-1260 (AROCHLOR 1260)	840	=	840	J	ug/kg	CC
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	ENDOSULFAN I	0.044	U	0.044	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	DELTA BHC	0.044	U	0.044	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	GAMMA BHC (LINDANE)	0.044	U	0.044	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	Chlordane	0.44	U	0.44	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	ALPHA-CHLORDANE	0.044	U	0.044	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	GAMMA-CHLORDANE	0.044	U	0.044	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	p,p'-DDD	0.089	U	0.089	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	p,p'-DDE	0.089	U	0.089	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	ALPHA BHC	0.044	U	0.044	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	DIELDRIN	0.089	U	0.089	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	ALDRIN	0.044	U	0.044	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	ENDOSULFAN II	0.089	U	0.089	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	ENDOSULFAN SULFATE	0.089	U	0.089	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	ENDRIN	0.089	U	0.089	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	ENDRIN ALDEHYDE	0.089	U	0.089	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	ENDRIN KETONE	0.089	U	0.089	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	HEPTACHLOR EPOXIDE	0.044	U	0.044	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	HEPTACHLOR	0.044	U	0.044	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	METHOXYCHLOR	0.42	U	0.42	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	p,p'-DDT	0.089	U	0.089	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	TOXAPHENE	2.8	U	2.8	R	ug/l	RE
CNC34	038EB017L1RE	S116351A*2*RE	SQ	PEST	SW8081	BETA BHC	0.044	U	0.044	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	p,p'-DDD	0.08	U	0.08	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	HEPTACHLOR EPOXIDE	0.04	U	0.04	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	ENDRIN KETONE	0.08	U	0.08	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	ENDRIN ALDEHYDE	0.08	U	0.08	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	ENDRIN	0.08	U	0.08	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	ENDOSULFAN SULFATE	0.08	U	0.08	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	ENDOSULFAN II	0.08	U	0.08	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	ENDOSULFAN I	0.04	U	0.04	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	DIELDRIN	0.08	U	0.08	R	ug/l	RE

Attachment 1 - Changed Qualifiers and Results
Zone A, SWMU 38 - Data Validation

SDG	Sample ID	Lab Sample ID	Matrix	Parameter Name	Analytical Method	Parameter	Lab Result	Lab Unit	Final Result	Final Unit	Qualifier	Comments
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	TOXAPHENE	2.5	U	2.5	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	p,p'-DDE	0.08	U	0.08	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	HEPTACHLOR	0.04	U	0.04	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	GAMMA-CHLORDANE	0.04	U	0.04	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	ALPHA-CHLORDANE	0.04	U	0.04	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	Chlordane	0.4	U	0.4	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	GAMMA BHC (LINDANE)	0.04	U	0.04	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	DELTA BHC	0.04	U	0.04	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	BETA BHC	0.04	U	0.04	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	ALPHA BHC	0.04	U	0.04	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	ALDRIN	0.04	U	0.04	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	METHOXYCHLOR	0.38	U	0.38	R	ug/l	RE
CNC34	038EW001L1RE	S116351A*4*RE	WQ	PEST	SW8081	p,p'-DDT	0.08	U	0.08	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	ENDOSULFAN SULFATE	0.08	U	0.08	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	DIELDRIN	0.08	U	0.08	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	ENDOSULFAN I	0.04	U	0.04	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	BETA BHC	0.04	U	0.04	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	DELTA BHC	0.04	U	0.04	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	GAMMA BHC (LINDANE)	0.04	U	0.04	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	Chlordane	0.4	U	0.4	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	ALPHA-CHLORDANE	0.04	U	0.04	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	GAMMA-CHLORDANE	0.04	U	0.04	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	p,p'-DDD	1	=	1	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	ALPHA BHC	0.04	U	0.04	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	p,p'-DDT	0.08	U	0.08	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	ALDRIN	0.04	U	0.04	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	ENDOSULFAN II	0.08	U	0.08	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	ENDRIN	0.08	U	0.08	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	ENDRIN ALDEHYDE	0.08	U	0.08	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	ENDRIN KETONE	0.08	U	0.08	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	HEPTACHLOR EPOXIDE	0.04	U	0.04	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	HEPTACHLOR	0.04	U	0.04	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	METHOXYCHLOR	0.38	U	0.38	R	ug/l	RE

Attachment 1 - Channed Qualifiers and Results
Zone A, SWI 3 - Data Validation

SDG	Sample ID	Lab Sample ID	Matrix	Parameter Class	Analysis Method	Parameter	Lab Result	Lab Qual	Final Result	Final Qual	Units	Reasons
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	TOXAPHENE	2.5	U	2.5	R	ug/l	RE
CNC34	038GW001L1	S116351A*3	WG	PEST	SW8081	p,p'-DDE	0.08	U	0.08	R	ug/l	RE
CNC34	038GW001L1RE	S116351A*3*RE	WG	PEST	SW8081	METHOXYCHLOR	0.38	U	0.38	UJ	ug/l	CC
CNC34	038SB01701	S116351A*1	SO	PEST	SW8081	p,p'-DDD	85	E	85	R	ug/kg	LR
CNC34	038SB01701	S116351A*1	SO	PEST	SW8081	p,p'-DDE	120	E	120	R	ug/kg	LR
CNC34	038SB01701	S116351A*1	SO	PEST	SW8081	p,p'-DDT	600	E	600	R	ug/kg	LR
CNC34	038SB01701DL	S116351A*1*DL	SO	PEST	SW8081	GAMMA BHC (LINDANE)	15	U	15	R	ug/kg	DL
CNC34	038SB01701DL	S116351A*1*DL	SO	PEST	SW8081	METHOXYCHLOR	150	U	150	R	ug/kg	DL
CNC34	038SB01701DL	S116351A*1*DL	SO	PEST	SW8081	HEPTACHLOR	15	U	15	R	ug/kg	DL
CNC34	038SB01701DL	S116351A*1*DL	SO	PEST	SW8081	HEPTACHLOR EPOXIDE	15	U	15	R	ug/kg	DL
CNC34	038SB01701DL	S116351A*1*DL	SO	PEST	SW8081	ENDRIN KETONE	29	U	29	R	ug/kg	DL
CNC34	038SB01701DL	S116351A*1*DL	SO	PEST	SW8081	ENDRIN ALDEHYDE	29	U	29	R	ug/kg	DL
CNC34	038SB01701DL	S116351A*1*DL	SO	PEST	SW8081	ENDRIN	29	U	29	R	ug/kg	DL
CNC34	038SB01701DL	S116351A*1*DL	SO	PEST	SW8081	ENDOSULFAN SULFATE	29	U	29	R	ug/kg	DL
CNC34	038SB01701DL	S116351A*1*DL	SO	PEST	SW8081	ENDOSULFAN I	15	U	15	R	ug/kg	DL
CNC34	038SB01701DL	S116351A*1*DL	SO	PEST	SW8081	GAMMA-CHLORDANE	15	U	15	R	ug/kg	DL
CNC34	038SB01701DL	S116351A*1*DL	SO	PEST	SW8081	TOXAPHENE	980	U	980	R	ug/kg	DL
CNC34	038SB01701DL	S116351A*1*DL	SO	PEST	SW8081	Chlordane	150	U	150	R	ug/kg	DL
CNC34	038SB01701DL	S116351A*1*DL	SO	PEST	SW8081	ENDOSULFAN II	29	U	29	R	ug/kg	DL
CNC34	038SB01701DL	S116351A*1*DL	SO	PEST	SW8081	DELTA BHC	15	U	15	R	ug/kg	DL
CNC34	038SB01701DL	S116351A*1*DL	SO	PEST	SW8081	BETA BHC	15	U	15	R	ug/kg	DL
CNC34	038SB01701DL	S116351A*1*DL	SO	PEST	SW8081	ALPHA BHC	15	U	15	R	ug/kg	DL
CNC34	038SB01701DL	S116351A*1*DL	SO	PEST	SW8081	ALDRIN	15	U	15	R	ug/kg	DL
CNC34	038SB01701DL	S116351A*1*DL	SO	PEST	SW8081	ALPHA-CHLORDANE	15	U	15	R	ug/kg	DL
CNC34	038SB01701DL	S116351A*1*DL	SO	PEST	SW8081	DIELDRIN	29	U	29	R	ug/kg	DL
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	ENDRIN KETONE	0.08	U	0.08	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	GAMMA-CHLORDANE	0.04	U	0.04	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	p,p'-DDD	0.08	U	0.08	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	p,p'-DDE	0.08	U	0.08	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	p,p'-DDT	0.08	U	0.08	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	DIELDRIN	0.08	U	0.08	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	ENDOSULFAN I	0.04	U	0.04	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	ENDOSULFAN II	0.08	U	0.08	R	ug/l	RE

Attachment 1 - Changed Qualifiers and Results
Zone A, SWMU 38 - Data Validation

SDG	Sample ID	Lab Sample ID	Matrix	Parameter	Analysis Method	Parameter	Lab Result	Lab Qual	Final Result	Final Qual	Unit	Comments
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	ENDOSULFAN SULFATE	0.08	U	0.08	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	ENDRIN ALDEHYDE	0.08	U	0.08	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	ALPHA BHC	0.04	U	0.04	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	DELTA BHC	0.04	U	0.04	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	HEPTACHLOR EPOXIDE	0.04	U	0.04	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	BETA BHC	0.04	U	0.04	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	HEPTACHLOR	0.04	U	0.04	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	METHOXYCHLOR	0.38	U	0.38	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	TOXAPHENE	2.5	U	2.5	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	Chlordane	0.4	U	0.4	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	GAMMA BHC (LINDANE)	0.04	U	0.04	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	ALDRIN	0.04	U	0.04	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	ALPHA-CHLORDANE	0.04	U	0.04	R	ug/l	RE
CNC39	038EB017L1RE	S116625*11*RE	SQ	PEST	SW8081	ENDRIN	0.08	U	0.08	R	ug/l	RE
CNC39	038SB01904	S116625*3	SO	PEST	SW8081	GAMMA BHC (LINDANE)	1.5	U	1.5	UJ	ug/kg	MS
CNC39	038SB02204	S116625*10	SO	PEST	SW8081	ALPHA-CHLORDANE	1.6	U	1.6	UJ	ug/kg	CC
CNC39	038SB02204	S116625*10	SO	PEST	SW8081	HEPTACHLOR EPOXIDE	1.6	U	1.6	UJ	ug/kg	CC
CNC39	038SB02204	S116625*10	SO	PEST	SW8081	METHOXYCHLOR	16	U	16	UJ	ug/kg	CC
CNC39	038SB02204	S116625*10	SO	PEST	SW8081	GAMMA-CHLORDANE	1.6	U	1.6	UJ	ug/kg	CC
CNC39	038SB02204	S116625*10	SO	PEST	SW8081	ENDOSULFAN II	3	U	3	UJ	ug/kg	CC

Engineering Comments Prepared by Jerry Stamps

SCDHEC General Comments:

1. Aroclor 1260 concentrations in samples A038SB011 (720 ppb) and A038SB006 (500 ppb) exceed the corresponding EPA Region III Residential RBC of 320 ppb and the generic SSL of 210 ppb (based upon a DAF = 10). This report utilizes the EPA action level of 1 ppm as presented in 40 CFR Part 761 to eliminate these detections as a concern. The Department maintains that screening data with respect to this action level is not appropriate. All screening must be conducted with respect to the EPA Region III RBCs and SSLs. Therefore, the Navy must evaluate the risk posed by the residual contamination. The Department recommends calculating a UCL95 over a half-acre area and screen the calculated value against the residential RBC. If sufficient data is not available to calculate a UCL95, then a focused risk assessment will be necessary to evaluate risk posed by the residual contamination. The Department anticipates that this approach will be similar to the approach taken for evaluating the risks posed by dioxins.

CH2M-Jones Response 1:

CH2M-Jones calculated the UCL95, as recommended, for the two detected PCBs (Aroclor-1254 and Aroclor-1260) at SWMU 38. The details of the calculation were presented in Section 4 of the Groundwater IM CR (attached). The resulting calculated UCL95 values were below the residential RBCs. Therefore, further evaluation of this issue is not warranted.

2. Section 4.0

A No Further Action (NFA) for this site is not appropriate at this time for the following reasons:

- a. The risk posed by the residual contamination has yet to be evaluated.
- b. The Department prefers to apply NFA determinations to sites as a whole rather than segregating NFAs for the individual media. Additionally, the PCB contaminated area of SWMU 38 is only one aspect of the contamination at this site. The pesticide-contaminated area located west of the area addressed by this Interim Measure is undergoing a separate IM and has yet to be completely remediated.

CH2M-Jones Response 2:

- a. See the response to comment #1*
- b. Comment noted.*

Hydrogeology Comments Prepared by Paul Bergstrand

1. A revised IMCR is not necessary. However, the comments/concerns presented in this correspondence must be addressed in the final document for this SWMU.

CH2M-Jones Response 1:
Comment noted.

2. The release mechanism/process of the PCB contamination has not been addressed. The release mechanism/process of the PCB contamination must be provided in the final document for this SWMU.

CH2M-Jones Response 2:
Review of available historical information has not revealed a possible PCB source at this site. Any discussion of possible release mechanisms would be speculative. One possibility is that transformers were stored along the fence line and a small amount of PCB containing fluid leaked from them. Although there is no evidence that this occurred, CH2M-Jones does not believe that further speculation about possible PCB sources is necessary, warranted, or required by RCRA regulations.

3. This report documents how PCB contaminated soils were excavated to depth of 1 foot. The report states that groundwater was encountered in the excavation at approximately 1 foot (i.e., from 6 to 12 inches below land surface (BLS)). The location or extent of the groundwater in the excavation was not reported. The extent of the groundwater in the excavation must be illustrated in the final document for this SWMU.

CH2M-Jones Response 3:
The groundwater encountered during the IM excavation was at the level of the final depth of the excavation. It was encountered in the early stages of the excavation and the field team decided to limit the excavation depth to just above the water level. Therefore the extent of the encountered groundwater is approximately the size of the excavator bucket.

4. Apparently the groundwater encountered in the excavation was not sampled. Not collecting a water sample from the excavation is an unfortunate oversight. A water sample from the excavation would provide analytical confirmation that groundwater is not contaminated. The Department strongly recommends the collection of a water sample to confirm the presence or absence of groundwater contamination. The burden of proof that groundwater is not impacted remains the responsibility of the Navy and must be addressed in the final document for this SWMU.

CH2M-Jones Response 4:

CH2M-Jones disagrees that not collecting a groundwater sample from the excavation was an unfortunate oversight. Groundwater encountered during the excavation is not representative of local groundwater conditions. An open excavation is prone to sloughing of surface soil and water from other sources migrating into the excavation. The water would also contain a very high level of suspended solids due to the mixing action associated with the use of excavation equipment. Additionally the bucket of the excavation equipment, which houses hydraulic lines and greased fittings, has been exposed to the water within the excavation. The source of any compounds detected in such a sample would be impossible to determine. Therefore, collecting a water sample from an open excavation would not provide data representative of groundwater conditions.

5. The chain of custody forms in this document indicate that two equipment blanks were analyzed. The analytical results of the equipment blank samples were apparently not included in this IMCR. Mr. Edens indicated that the equipment blank data was reviewed within the Data Validation Summary but was not specifically listed. Because this data is part of the public record, all quality control data must be provided in the final document for this SWMU.

CH2M-Jones Response 5:

The data for the two samples in question (038EB027M4 and 038EB032M5) are summarized in the attached data summary table.

6. The text on page 2-1 and the chain of custody forms indicate that soil samples 27, 28, and 29 were collected from 1 to 2 feet BLS. The Analytical Data Summary Tables, however, show the same soil samples as being collected from 3 to 5 feet BLS. The correct sample depth must be addressed in the final document for this SWMU.

CH2M-Jones Response 6:

The text and chain of custody report the correct sample interval. It was incorrectly entered into the database. A revised data summary table is attached.

Analytical Data Summary

09/03/2002 4:21 PM

Parameter	StationID SampleID DateCollected DateExtracted DateAnalyzed SDGNumber Units	FIELDQC		FIELDQC	
		038EB027M4		038EB032M5	
		03/26/2002		04/29/2002	
		03/28/2002		05/01/2002	
		03/29/2002		05/02/2002	
		CNC80		CNC101	
PCB-1016 (Arochlor 1016)	ug/l	1	U	1	U
PCB-1221 (Arochlor 1221)	ug/l	1	U	1	U
PCB-1232 (Arochlor 1232)	ug/l	1	U	1	U
PCB-1242 (Arochlor 1242)	ug/l	1	U	1	U
PCB-1248 (Arochlor 1248)	ug/l	1	U	1	U
PCB-1254 (Arochlor 1254)	ug/l	2	U	2	U
PCB-1260 (Arochlor 1260)	ug/l	2	U	2	U

	StationID	FIELDQC	
	SampleID	038EB027M4	
	DateCollected	03/26/2002	
	DateExtracted	03/28/2002	
	DateAnalyzed	03/29/2002	
	SDGNumber	CNC80	
Parameter	Units		
Aldrin	ug/l	0.04	U
Alpha BHC (Alpha Hexachlorocyclohexane)	ug/l	0.04	U
Alpha-chlordane	ug/l	0.04	U
Beta BHC (Beta Hexachlorocyclohexane)	ug/l	0.04	U
Chlordane	ug/l	0.4	U
Delta BHC (Delta Hexachlorocyclohexane)	ug/l	0.04	U
Dieldrin	ug/l	0.08	U
Endosulfan I	ug/l	0.04	U
Endosulfan II	ug/l	0.08	U
Endosulfan Sulfate	ug/l	0.08	U
Endrin Aldehyde	ug/l	0.08	U
Endrin Ketone	ug/l	0.08	U
Endrin	ug/l	0.08	U
Gamma BHC (Lindane)	ug/l	0.04	U
Gamma-chlordane	ug/l	0.04	U
Heptachlor Epoxide	ug/l	0.04	U
Heptachlor	ug/l	0.04	U
Methoxychlor	ug/l	0.38	U
p,p'-DDD	ug/l	0.08	U
p,p'-DDE	ug/l	0.08	U
p,p'-DDT	ug/l	0.08	U
Toxaphene	ug/l	2.5	U



PROJECT NUMBER 158814	BORING NUMBER AO38GW004
SOIL BORING LOG	

PROJECT : Charleston Naval Complex - Zone A SWMU 38 LOCATION : Charleston, SC NORTHING: 381712.2
 ELEVATION : 7.27 DRILLING CONTRACTOR Columbia Technologies License # 1485 EASTING: 2315766.3
 DRILLING METHOD AND EQUIPMENT USED : DPT-2
 WATER LEVELS : Not Measured START : 02/19/2002 END: 02/19/2002 LOGGER : Darryl Gates/Navarre

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)		STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION	COMMENTS
		RECOVERY (IN)			
		#/TYPE			
0-5				CLAYEY SAND, brown	
5-5.5				SANDY GRAVEL (1/4"), brown	
5.5-12				CLAYEY SAND, light brown to brown	

Boring Terminated at 12 Feet



PROJECT NUMBER

158814

WELL NUMBER

AO38GW004

SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : SWMU 38, Zone A, Charleston Naval Complex

LOCATION : Charleston, South Carolina

DRILLING CONTRACTOR : Columbia Technologies License # 1485

NORTHING: 381712.2

DRILLING METHOD AND EQUIPMENT USED : Hollow stem augers

EASTING: 2315766.3

NORTHING: 381,712.2

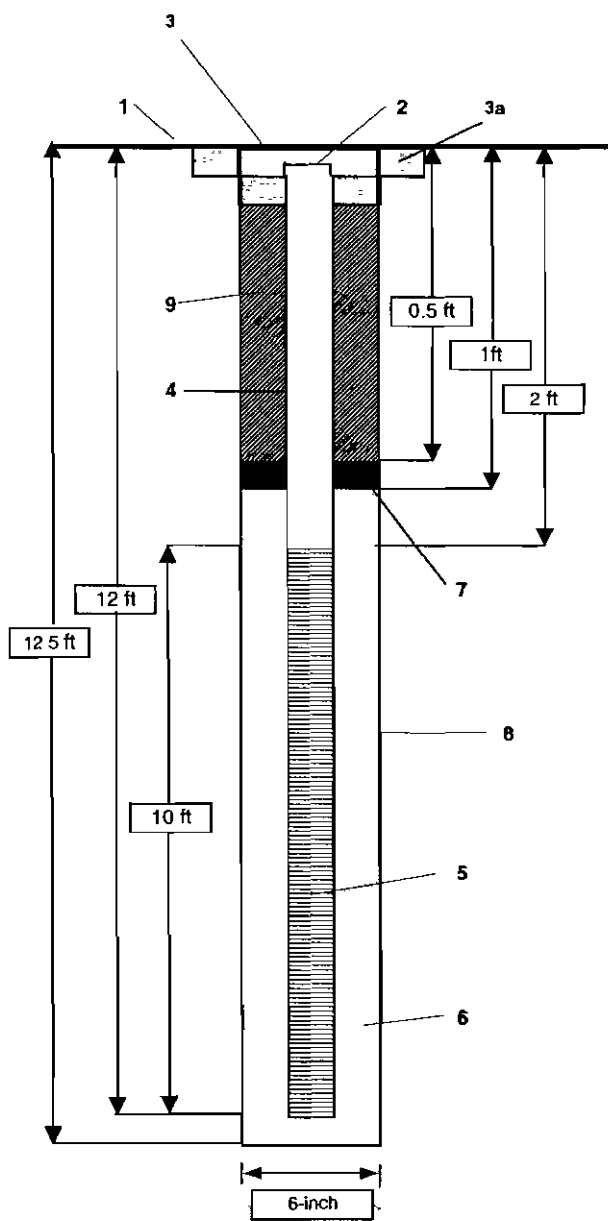
EASTING: 2,315,766.3

WATER LEVELS : 2.5' b/s

START : 2/19/02

END: 2/19/02

LOGGER : Darryl Gates



1- Ground elevation at well

2- Top of casing elevation

7.27 ft above msl

3- Protective cover type

flush mount manhole vault

a) concrete pad dimensions

2 ft x 2 ft x 6" deep

4- Dia./type of well casing

2-inch inside diameter schedule 40 PVC

5- Type/slot size of screen

0.010-inch slotted PVC

6- Type filter pack

20/30 Sieve Size Silica Sand (5 bags)

7- Type of seal

3/8-inch bentonite chips

8- Borehole diameter

6-inch

9- Grout

Portland cement

Note: Diagram not to scale.



PROJECT NUMBER 158814	BORING NUMBER AO38GW005
SOIL BORING LOG	

PROJECT : Charleston Naval Complex - Zone A SWMU 38 LOCATION : Charleston, SC NORTHING: 381738.1
 ELEVATION : 7 DRILLING CONTRACTOR : Columbia Technologies License # 1485 EASTING: 2315783.6

DRILLING METHOD AND EQUIPMENT USED **DPT 2**

WATER LEVELS : Not Measured START : 02/19/2002 END: 02/19/2002 LOGGER : Darryl Gates/Navarre

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)		STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	RECOVERY (IN)	#/TYPE			
0 - 5				CLAYEY SAND, brown	
5 - 5.5				SANDY GRAVEL (1/4"), brown	
5.5 - 12				CLAYEY SAND, light brown to brown	

Boring terminated at 12 Feet



PROJECT NUMBER
158814

WELL NUMBER
AO38GW005

SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : SWMU 38, Zone A, Charleston Naval Complex

LOCATION : Charleston, South Carolina

DRILLING CONTRACTOR : Columbia Technologies License # 1485

NORTHING: 381738.3

DRILLING METHOD AND EQUIPMENT USED : Hollow stem augers

EASTING: 2315783.6

NORTHING: 381,738.3

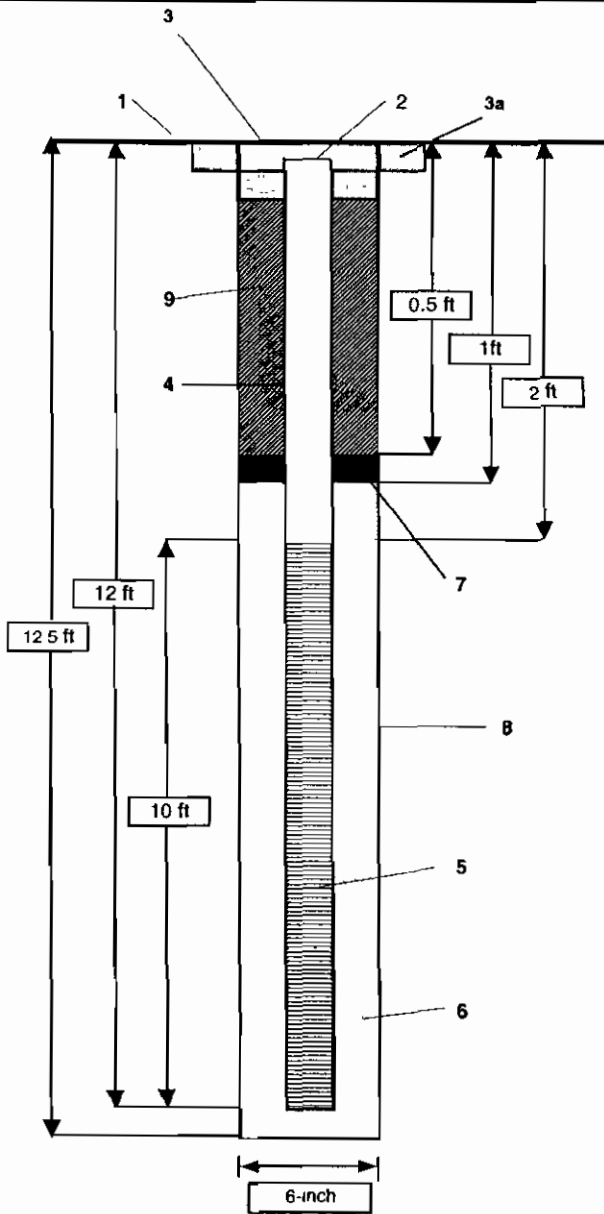
EASTING: 2,315,783.6

WATER LEVELS : 2.5' bls

START : 2/19/02

END: 2/19/02

LOGGER : Darryl Gates



- | | |
|-----------------------------|--|
| 1- Ground elevation at well | |
| 2- Top of casing elevation | 7 ft above msl |
| 3- Protective cover type | flush mount manhole vault |
| a) concrete pad dimensions | 2 ft x 2 ft x 6" deep |
| 4- Dia./type of well casing | 2-inch inside diameter schedule 40 PVC |
| 5- Type/slot size of screen | 0.010-inch slotted PVC |
| 6- Type filter pack | 20/30 Sieve Size Silica Sand (5 bags) |
| 7- Type of seal | 3/8-inch bentonite chips |
| 8- Borehole diameter | 6-inch |
| 9- Grout | Portland cement |

Note: Diagram not to scale.

Appendix C

SWMU 38: Soil - Hypothetical Future Residential (Child) Scenario
Zone, CNC, SC

	<u>Carcinogenic</u>	<u>Noncarcinogenic</u>
Ingestion:		
Intake for non-carcinogenic compounds:		
CDI =	Age-specific intake (for carcinogenic compounds only):	
$\frac{Cs \cdot IR \cdot FI \cdot ET \cdot EF \cdot ED \cdot CF}{BW \cdot AT}$	$\frac{Cs \cdot FI \cdot ET \cdot EF \cdot CF \cdot IR_{adj}}{AT}$	
Cs = Concentration in soil (mg/kg)	RME	RME
IR = Ingestion Rate (mg/day)	N/A	200 a
IR_{adj} = Age-Specific Factor (ingestion) (mg - year)/(kg - day)	200.00 c	N/A
FI = Fraction Ingested (unitless)	100%	100%
ET = Exposure Time (4 hours per 24-hour day)	1.000 b	1.000 b
EF = Exposure Frequency (day/year)	350 a	350 a
ED = Exposure Duration (year)	N/A	6 a
CF = Conversion Factor (kg/mg)	1.00E-06	1.00E-06
BW = Body Weight (kg)	N/A	15 a
AT = Averaging Time (days)	25550 a	2190 a
Dermal:		
CDI =		
$\frac{Cs \cdot SA \cdot AF \cdot ABS \cdot ET \cdot EF \cdot ED \cdot CF}{BW \cdot AT}$		
Cs = Concentration in soil (mg/kg)	RME	RME
SA = Surface Area (cm ²)	1418 d	1418 d
AF = Soil-Skin Adherence Factor (mg/cm ²)	1 e	1 e
ABS = Absorption Factor (unitless)	(Chemical Specific) g	(Chemical Specific) g
ET = Exposure Time (4 hours per 24-hour day)	1.000 b	1.000 b
EF = Exposure Frequency (day/year)	350 a	350 a
ED = Exposure Duration (year)	6 a	6 a
CF = Conversion Factor (kg/mg)	1.00E-06	1.00E-06
BW = Body Weight (kg)	15 a	15 a
AT = Averaging Time (days)	25550 a	2190 a
Inhalation:		
CDI =		
$\frac{Cs \cdot (1/PEF) \cdot IR \cdot ET \cdot EF \cdot ED}{BW \cdot AT}$		
Cs = Concentration in soil (mg/kg)	RME	RME
PEF = Particulate Emission Factor (m ³ /kg)	1.32E+09 f	1.32E+09 f
IR = Inhalation Rate (m ³ /day)	15 a	15 a
ET = Exposure Time (4 hours per 24-hour day)	0.167 b	0.167 b
EF = Exposure Frequency (day/year)	350 a	350 a
ED = Exposure Duration (year)	6 a	6 a
BW = Body Weight (kg)	15 a	15 a
AT = Averaging Time (days)	25550 a	2190 a

References:

a = U.S. EPA, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors," OSWER Directive 9285.6-03, March 25, 1991.

b = Time spent outdoors in the contaminated areas using best professional judgement, based on the nature of the activity per NASA 1997 workplan.

c = Age-adjusted ingestion rate for adults, adjusted for body weight and time for carcinogenic exposure.

$$IR_{adj} = \frac{IRc \times EC}{BWc} + \frac{IRa \times (EDa - EDc)}{BWA} = \frac{200 \times 6}{15} + \frac{100 \times (30-6)}{70}$$

$$= 200.00 \text{ (mg-year)/(kg-day)}$$

d = Surface area of hands, 1/2 arms and feet of an adult for exposure to soils, adapted from CEHT, Technical Report: Soil Cleanup Target Levels for FDEP, September 2, 1997.

e = U.S. EPA Dermal Exposure Assessment: Principles and Application, January 1992.

f = Particulate emission factor (PEF), adapted from U.S.EPA, Soil Screening Guidance: Technical Background Document, May 1996.

g = Chemical-specific absorption factors are found in Table 8.4 & Appendix C

SWMU 38: Soil - Hypothetical Future Residential (Child) Carcinogenic Scenario
Zone, CNC, SC

Units	Chemical	WOE	SFo	SFI	RME	ABS	Ingestion		Dermal		Inhalation	
							CDI	ELCR	CDI	ELCR	CDI	ELCR
MG/KG	Aroclor-1260	B2	2.00E+00		2.38E-01	0.06	2.72E-07	5.45E-07	1.85E-08	3.70E-08	2.47E-12	
Total Risk							5.45E-07		3.70E-08		Total Risk = 5.82E-07	

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure Concentration;
 ELCR = Excess Lifetime Cancer Risk

SWMU 38: Soil - Hypothetical Future Residential (Adult) Scenario
Zone A, CNC, SC

		<u>Carcinogenic</u>	<u>Noncarcinogenic</u>
Ingestion:		Age-specific intake (for carcinogenic compounds only):	
Intake for non-carcinogenic compounds:			
CDI =	$\frac{Cs \cdot IR \cdot FI \cdot ET \cdot EF \cdot ED \cdot CF}{BW \cdot AT}$	CDI_{adj} =	$\frac{Cs \cdot FI \cdot ET \cdot EF \cdot CF \cdot IR_{adj}}{AT}$
Cs =	Concentration in soil (mg/kg)	RME	RME
IR =	Ingestion Rate (mg/day)	N/A	100 a
IR_{adj} =	Age-Specific Factor (ingestion) (mg - year)/(kg - day)	114.29 c	N/A
FI =	Fraction Ingested (unitless)	100%	100%
EF =	Exposure Frequency (day/year)	350 a	350 a
ED =	Exposure Duration (year)	N/A	30 a
CF =	Conversion Factor (kg/mg)	1.00E-06	1.00E-06
BW =	Body Weight (kg)	N/A	70 a
AT =	Averaging Time (days)	25550 a	10950 a
Dermal:			
CDI =	$\frac{Cs \cdot SA \cdot AF \cdot ABS \cdot ET \cdot EF \cdot ED \cdot CF}{BW \cdot AT}$		
Cs =	Concentration in soil (mg/kg)	RME	RME
SA =	Surface Area (cm ²)	2936 d	2936 d
AF =	Soil-Skin Adherence Factor (mg/cm ²)	1 e	1 e
ABS =	Absorption Factor (unitless)	(Chemical Specific) g	(Chemical Specific) g
ET =	Exposure Time (4 hours per 24-hour day)	0.167 b	0.167 b
EF =	Exposure Frequency (day/year)	350 a	350 a
ED =	Exposure Duration (year)	30 a	30 a
CF =	Conversion Factor (kg/mg)	1.00E-06	1.00E-06
BW =	Body Weight (kg)	70 a	70 a
AT =	Averaging Time (days)	25550 a	10950 a
Inhalation:			
CDI =	$\frac{Cs \cdot (1/PEF) \cdot IR \cdot ET \cdot EF \cdot ED}{BW \cdot AT}$		
Cs =	Concentration in soil (mg/kg)	RME	RME
PEF =	Particulate Emission Factor (m ³ /kg)	1.32E+09 f	1.32E+09 f
IR =	Inhalation Rate (m ³ /day)	20 a	20 a
ET =	Exposure Time (4 hours per 24-hour day)	0.167 b	0.167 b
EF =	Exposure Frequency (day/year)	350 a	350 a
ED =	Exposure Duration (year)	30 a	30 a
BW =	Body Weight (kg)	70 a	70 a
AT =	Averaging Time (days)	25550 a	10950 a

References:

a = U.S. EPA, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors," OSWER Directive 9285.6-03, March 25, 1991.

b = Time spent outdoors in the contaminated areas using best professional judgement, based on the nature of the activity per NASA 1997 workplan.

c = Age-adjusted ingestion rate for adults, adjusted for body weight and time for carcinogenic exposure.

$$IR_{adj} = \frac{IRc \times ED}{BWc} + \frac{IRa \times (EDa - EDc)}{BWa} = \frac{200 \times 6}{15} + \frac{100 \times (30-6)}{70}$$

$$= 114.29 \text{ (mg-year)/(kg-day)}$$

d = Surface area of hands, 1/2 arms and feet of an adult for exposure to soils, adapted from CEHT, Technical Report: Soil Cleanup Target Levels for FDEP, September 2, 1997.

e = U.S. EPA Dermal Exposure Assessment: Principles and Application, January 1992.

f = Particulate emission factor (PEF), adapted from U.S.EPA, Soil Screening Guidance: Technical Background Document, May 1996.

g = Chemical-specific absorption factors are found in Table 8.4 & Appendix C

SWMU 38: Soil - Hypothetical Future Residential (Adult) Carcinogenic Scenario
Zone A, CNC, SC

Units	Chemical	WOE	Sf _o	Sf _i	RME	ABS	<u>Ingestion</u>		<u>Dermal</u>		<u>Inhalation</u>	
							CDI _{adj}	ELCR	CDI	ELCR	CDI	ELCR
MG/KG	Aroclor-1260	B2	2.00E+00		2.38E-01	0.06	3.73E-07	7.46E-07	4.11E-08	8.23E-08	3.54E-12	
Total Risk							7.46E-07		8.23E-08		Total Risk = 8.28E-07	

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure Concentration;
 ELCR = Excess Lifetime Cancer Risk

Groundwater (Potable Use) - Hypothetical Future Residential Child Scenario - All Chemicals**Zone A, CNC**

	<u>Carcinogenic</u>	<u>Noncarcinogenic</u>
Ingestion:		
Intake for non-carcinogenic and carcinogenic compounds:		
CDI =	$\frac{C_{gw} \cdot IR \cdot EF \cdot ED}{BW \cdot AT}$	
C_{gw} =	Concentration in groundwater (mg/L)	RME
IR =	Ingestion Rate (L/day)	1 a
EF =	Exposure Frequency (day/year)	350 a
ED =	Exposure Duration (year)	6 a
BW =	Body Weight (kg)	15 a
AT =	Averaging Time (days)	25550 a

Inhalation:**CDI = Ingestion CDI from above^f****References:**

- a = U.S. EPA, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" OSWER Directive 9285.6-03, March 25, 1991.
- b = US EPA Exposure Factors Handbook, August 1997.
- Manual, Supplemental Guidance, Dermal Risk Assessment, Interim Guidance, May 1998.
- c = Total Body Surface Area represents whole body (average of male & female children (1-6 years old)).
- d = Dermal Permeability Constant for water (0.001) used for constituents without a PC value; all values adapted from EPA, Dermal Exposure Assessment: Principles and Applications, January 1992.
- e = 10 minute event x 1 hour/60 minutes x 1 day/24 hours = 0.007 day per event.
- f = follows EPA Region IV guidance (i.e., inhalation of groundwater volatiles while showering/bathing is accounted for by doubling the ingestion volume), USEPA Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment, Interim, November 1995.

Groundwater (Potable Use) - Future Residential Child Carcinogenic Scenario - All Chemicals**Zone A, CNC**

Units	Chemical	WOE	SFo	SFi	RME	Ingestion		Inhalation*
						CDI	ELCR	ELCR
MG/L	4,4-DDD		2.40E-01		5.72E-04	3.13E-06	7.5E-07	
MG/L	Heptachlor		4.50E+00	4.50E+00	2.05E-05	1.12E-07	5.1E-07	5.1E-07
MG/L	Acetone				2.31E-01	1.27E-03		
Total Risk							1.3E-06	5.1E-07
Total Risk =							1.8E-06	

Notes:

WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure;

ELCR = Excess Lifetime Cancer Risk, * = inhalation intake (CDI) = ingestion intake

Groundwater (Potable Use) - Hypothetical Future Residential Child Non-Carcinogenic Scenario - All Chemicals

Zone A, CNC

Units	Chemical	WOE	RfDo	RfDd	RfDi	RME	Ingestion		Inhalation*
							CDI	HQ	HQ
MG/L	4,4-DDD					5.72E-04	3.66E-05		
MG/L	Heptachlor		5.00E-04			2.05E-05	1.31E-06	2.6E-03	
MG/L	Acetone		1.00E-01			2.31E-01	1.48E-02	1.5E-01	
Hazard Index								1.5E-01	
Total Hazard Index =								1.5E-01	

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure;

Groundwater (Potable Use) - Hypothetical Future Residential Adult Scenario - All Chemicals**Zone A, CNC**

		<u>Carcinogenic</u>	<u>Noncarcinogenic</u>
Ingestion:			
Intake for non-carcinogenic compounds:		Age-specific intake (for carcinogenic compounds only):	
CDI =	$\frac{C_{gw} * IR * EF * ED}{BW * AT}$	CDI_{adj} =	$\frac{C_{gw} * EF * CF * IR_{adj}}{AT}$
C_{gw} =	Concentration in groundwater (mg/L)	RME	RME
IR =	Ingestion Rate (L/day)	N/A	2 a
IR_{adj} =	Age-adjusted Ingestion Rate (L-year/kg-day)	1.1 b	N/A
EF =	Exposure Frequency (day/year)	350 a	350 a
ED =	Exposure Duration (year)	30 a	30 a
BW =	Body Weight (kg)	70 a	70 a
AT =	Averaging Time (days)	25550 a	10950 a

Inhalation:**CDI = Ingestion CDI from above¹****References:**

a = U.S. EPA, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" OSWER Directive 9285.6-03, March 25, 1991.

b = Age-adjusted ingestion rate for adults, adjusted for body weight and time for carcinogenic exposure.

$$IR_{adj} = \frac{IR_c \times ED_c}{BW_c} + \frac{IR_a \times (ED_a - ED_c)}{BW_a} = \frac{1 \times 6}{15} + \frac{2 \times (30-6)}{70}$$

1.09 (L-year)/(kg-day)

b = USEPA Exposure Factors Handbook, August 1997

c = Total Body Surface Area represents whole body (average of male & female adults).

f = Age-adjusted surface area for adults, adjusted for body weight and time for carcinogenic exposure.

$$SA_{adj} = \frac{SA_c \times ED_c}{BW_c} + \frac{SA_a \times (ED_a - ED_c)}{BW_a} = \frac{6557 \times 6}{15} + \frac{20000 \times (30-6)}{70}$$

9480 (cm²-year)/(kg)

d = Dermal Permeability Constant for water (0.001) used for constituents without a PC value; all values adapted from EPA, Dermal Exposure Assessment: Principles and Applications, January 1992.

e = 10 minute event x 1 hour/60 minutes x 1 day/24 hours = 0.007 day per event.

f = follows EPA Region IV guidance (i.e., inhalation of groundwater volatiles while showering/bathing is accounted for by doubling the ingestion volume), USEPA Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment, Interim, November 1995.

Groundwater (Potable Use) - Hypothetical Future Residential Adult Carcinogenic Scenario - All Chemicals

Zone A, CNC

Units	Chemical	WOE	SFo	SFi	RME	Ingestion		Inhalation*
						CDI	ELCR	ELCR
MG/L	4,4-DDD		2.40E-01		5.72E-04	8.51E-06	2.0E-06	
MG/L	Heptachlor		4.50E+00	4.50E+00	2.05E-05	3.05E-07	1.4E-06	1.4E-06
MG/L	Acetone				2.31E-01	3.44E-03		
MG/L	Cis-1,2-DCE				3.61E-03	5.37E-05		
MG/L	Total 1,2-DCE				4.67E-03	6.95E-05		
MG/L	Vinyl Chloride		7.20E-01	1.50E-02	9.95E-03	1.48E-04	1.1E-04	
Total Risk							1.10E-04	1.4E-06
							Total Risk =	1E-04

Notes:

WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure;

ELCR = Excess Lifetime Cancer Risk, * = inhalation intake (CDI) = ingestion intake

Groundwater (Potable Use) - Hypothetical Future Residential Adult Non-Carcinogenic Scenario - All Chemicals
Zone A, CNC

Units	Chemical	WOE	RfDo	RfDi	RME	Ingestion		Inhalation*
						CDI	HQ	HQ
MG/L	4,4-DDD				5.72E-04	1.57E-05		
MG/L	Heptachlor		5.00E-04		2.05E-05	5.62E-07	1.1E-03	
MG/L	Acetone		1.00E-01		2.31E-01	6.33E-03	6.3E-02	
MG/L	Cis-1,2-DCE		1.00E-02		3.61E-03	9.89E-05	9.9E-03	
MG/L	Total 1,2-DCE		9.00E-03		4.67E-03	1.28E-04	1.4E-02	
MG/L	Vinyl Chloride		3.00E-03	2.80E-02	9.95E-03	2.73E-04	9.1E-02	9.7E-03
Hazard Index							1.8E-01	9.7E-03
Total Hazard Index =							1.9E-01	

Notes:

WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure;

HQ = Hazard Quotient; HI = Hazard Index; * = inhalation intake (CDI) = ingestion intake

Groundwater (Potable Use) - Hypothetical Future Residential Adult Scenario - All Chemicals**Zone A, CNC**

	Carcinogenic	Noncarcinogenic
Ingestion:		
Intake for non-carcinogenic compounds:		
Age-specific intake (for carcinogenic compounds only):		
CDI = $\frac{C_{gw} \cdot IR \cdot EF \cdot ED}{BW \cdot AT}$	CDI_{adj} = $\frac{C_{gw} \cdot EF \cdot CF \cdot IR_{adj}}{AT}$	
C_{gw} =	RME	RME
IR =	N/A	2 a
IR_{adj} =	1.1 b	N/A
EF =	350 a	350 a
ED =	30 a	30 a
BW =	70 a	70 a
AT =	25550 a	10950 a

Inhalation:**CDI** = Ingestion CDI from above^f**References:**

a = U.S. EPA, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" OSWER Directive 9285.6-03, March 25, 1991.

b = Age-adjusted ingestion rate for adults, adjusted for body weight and time for carcinogenic exposure.

$$IR_{adj} = \frac{IR_c \times ED_c}{BW_c} + \frac{IR_a \times (ED_a - ED_c)}{BW_a} = \frac{1 \times 6}{15} + \frac{2 \times (30-6)}{70}$$

1.09 (L-year)/(kg-day)

b = USEPA Exposure Factors Handbook, August 1997

c = Total Body Surface Area represents whole body (average of male & female adults).

f = Age-adjusted surface area for adults, adjusted for body weight and time for carcinogenic exposure.

$$SA_{adj} = \frac{SA_c \times ED_c}{BW_c} + \frac{SA_a \times (ED_a - ED_c)}{BW_a} = \frac{6557 \times 6}{15} + \frac{20000 \times (30-6)}{70}$$

9480 (cm²-year)/(kg)

d = Dermal Permeability Constant for water (0.001) used for constituents without a PC value; all values adapted from EPA, Dermal Exposure Assessment: Principles and Applications, January 1992.

e = 10 minute event x 1 hour/60 minutes x 1 day/24 hours = 0.007 day per event.

f = follows EPA Region IV guidance (i.e., inhalation of groundwater volatiles while showering/bathing is accounted for by doubling the ingestion volume), USEPA Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment, Interim, November 1995.

Groundwater (Potable Use) - Hypothetical Future Residential Adult Carcinogenic Scenario - All Chemicals*Zone A, CNC*

Units	Chemical	WOE	SFo	SFi	RME	Ingestion		Inhalation*
						CDI	ELCR	ELCR
MG/L	4,4-DDD		2.40E-01		5.72E-04	8.51E-06	2.0E-06	
MG/L	Heptachlor		4.50E+00	4.50E+00	2.05E-05	3.05E-07	1.4E-06	1.4E-06
MG/L	Acetone				2.31E-01	3.44E-03		
Total Risk							3.4E-06	1.4E-06
							Total Risk =	5E-06

Notes:

WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure;

ELCR = Excess Lifetime Cancer Risk, * = inhalation intake (CDI) = ingestion intake

Groundwater (Potable Use) - Hypothetical Future Residential Adult Non-Carcinogenic Scenario - All Chemicals
Zone A, CNC

Units	Chemical	WOE	RfDo	RfDi	RME	Ingestion		Inhalation*
						CDI	HQ	HQ
MG/L	4,4-DDD				5.72E-04	1.57E-05		
MG/L	Heptachlor		5.00E-04		2.05E-05	5.62E-07	1.1E-03	
MG/L	Acetone		1.00E-01		2.31E-01	6.33E-03	6.3E-02	
Hazard Index							6.4E-02	
Total Hazard Index =							0.064	

Notes:

WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure;

HQ = Hazard Quotient; HI = Hazard Index; * = inhalation intake (CDI) = ingestion intake

Groundwater (Potable Use) - Hypothetical Future Residential Child Scenario - All Chemicals**Zone A, CNC**

	<u>Carcinogenic</u>	<u>Noncarcinogenic</u>
Ingestion:		
Intake for non-carcinogenic and carcinogenic compounds:		
CDI =	$\frac{C_{gw} * IR * EF * ED}{BW * AT}$	
C_{gw} =	Concentration in groundwater (mg/L)	RME
IR =	Ingestion Rate (L/day)	1 a
EF =	Exposure Frequency (day/year)	350 a
ED =	Exposure Duration (year)	6 a
BW =	Body Weight (kg)	15 a
AT =	Averaging Time (days)	25550 a
Dermal:		
Intake for non-carcinogenic and carcinogenic compounds:		
CDI =	$\frac{C_{gw} * SA * PC * ET * EF * ED * CF}{BW * AT}$	
C_{gw} =	Concentration in groundwater (mg/L)	RME
SA =	Surface Area (cm ²)	6557 b, c
PC =	Dermal Permeability Constant (cm/hr)	(Chemical Specific) d
ET =	Exposure Time (hr/day)	0.007 b,e
EF =	Exposure Frequency (day/year)	350 a
ED =	Exposure Duration (year)	6 a
CF =	Conversion Factor (L/cm ³)	1.00E-03
BW =	Body Weight (kg)	15 a
AT =	Averaging Time (days)	25550 a

Inhalation:**CDI = Ingestion CDI from above^f****References:**

- a = U.S. EPA, Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" OSWER Directive 9285.6-03, March 25, 1991.
- b = US EPA Exposure Factors Handbook, August 1997.
- c = Total Body Surface Area represents whole body (average of male & female children (1-6 years old)).
- d = Dermal Permeability Constant for water (0.001) used for constituents without a PC value; all values adapted from EPA, Dermal Exposure Assessment: Principles and Applications, January 1992.
- e = 10 minute event x 1 hour/60 minutes x 1 day/24 hours = 0.007 day per event.
- f = follows EPA Region IV guidance (i.e., inhalation of groundwater volatiles while showering/bathing is accounted for by doubling the ingestion volume), USEPA Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment, Interim, November 1995.

Groundwater (Potable Use) - Future Residential Child Carcinogenic Scenario - All Chemicals*Zone A, CNC*

Units	Chemical	WOE	SFo	SFI	RME	Ingestion		Inhalation*
						CDI	ELCR	ELCR
MG/L	4,4-DDD		2.40E-01		5.72E-04	3.13E-06	7.5E-07	
MG/L	Heptachlor		4.50E+00	4.50E+00	2.05E-05	1.12E-07	5.1E-07	5.1E-07
MG/L	Acetone				2.31E-01	1.27E-03		
MG/L	Cis-1,2-DCE				3.61E-03	1.98E-05		
MG/L	Total 1,2-DCE				4.67E-03	2.56E-05		
MG/L	Vinyl Chloride		1.40E+00	3.00E-02	9.95E-03	5.45E-05	7.6E-05	
Total Risk							7.8E-05	5.1E-07
Notes:							Total Risk =	8E-05

WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure;
 ELCR = Excess Lifetime Cancer Risk, * = inhalation intake (CDI) = ingestion intake

Groundwater (Potable Use) - Hypothetical Future Residential Child Non-Carcinogenic Scenario - All Chemicals
Zone A, CNC

Units	Chemical	WOE	RfDo	RfDd	RfDI	RME	Ingestion		Inhalation*
							CDI	HQ	HQ
MG/L	4,4-DDD					5.72E-04	3.66E-05		
MG/L	Heptachlor		5.00E-04			2.05E-05	1.31E-06	2.6E-03	
MG/L	Acetone		1.00E-01			2.31E-01	1.48E-02	1.5E-01	
MG/L	Cis-1,2-DCE		1.00E-02			3.61E-03	2.31E-04	2.3E-02	
MG/L	Total 1,2-DCE		9.00E-03			4.67E-03	2.99E-04	3.3E-02	
MG/L	Vinyl Chloride		3.00E-03		2.80E-02	9.95E-03	6.36E-04	2.1E-01	2.3E-02
	Hazard Index							4.2E-01	2.3E-02
						Total Hazard Index =		4.4E-01	

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure;